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GAUNTLET SF₆ ATMOSPHERIC TRACER RELEASE AND FIELD TEST SUPPORT

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ABSTRACT

This study was undertaken to assist the Air Force Technical Applications Center (AFTAC) in conducting a sulfur hexafluoride SF₆ tracer test known as GAUNTLET at the Dugway Proving Ground, UT. Seven separate 4-hour long releases of SF₆ were performed during the month of April, 2001, during both daytime and nighttime conditions. Wind directions were selected to be generally either southeasterly or northwesterly. The resulting SF₆ tracer plume was tracked at maximum distances of 80 km from the release site. Plume tracking was accomplished by the use of three real-time SF₆ analyzers specially modified to fit in sport utility vehicles equipped to handle the rough, back country of the experiment domain. A total of 247 traverses were made across the various sampling routes by the three vehicles. Of those traverses, 153 resulted in usable measurements of the SF₆ plume. These measurements helped describe the size and concentration of the SF₆ plume. Ninety-three traverses resulted in no measurements of SF₆. These measurements helped to determine the arrival and departure of the SF₆ plume. Complete descriptions of each test, including SF₆ tracer release mechanism performance, SF₆ tracer plume measurements, SF₆ real-time analyzer performance, and general meteorological observations are provided. Detailed SF₆ plume traverses are individually presented in the Appendix.

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INTRODUCTION

The Field Research Division (FRD) of the National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory (ARL) was commissioned in 2000 to assist with the GAUNTLET program, sponsored by the Air Force Technical Applications Center (AFTAC) at Patrick AFB, FL. FRD's portion of the program involved primarily the use of its sulfur hexafluoride (SF₆) tracer release and real-time SF₆ sampling and analysis technology in a series of field tests at the U.S. Army's Dugway Proving Ground (DPG). Two separate statements of work involving both FRD and DPG were necessary to accomplish the goals of the field test. The FRD statement of work required FRD to provide SF₆ tracer releases and SF₆ mobile tracer detection. Under this agreement, FRD supported AFTAC in 7 full-scale GAUNTLET field tests. It was also tasked to support AFTAC in the Divine Umpire program, which was similarly scheduled to be conducted at DPG. However, the persistent and repeated delays in the Divine Umpire program forced AFTAC to abandon its test plan. Our plans for Divine Umpire were subsequently scrubbed, as well. This report describes the FRD support of Divine Umpire and the full-scale field deployment of GAUNTLET. The efforts of DPG will be reported by that institution.

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STATEMENT OF WORK SUMMARY

The original statement of work was designed to support the GAUNTLET program. The statement of work assumed that DPG would be responsible for almost all aspects of the tests (except for the release and real-time measurement of SF₆), as follows: 1) all tests were to be conducted at DPG, 2) DPG assumed full responsibility for obtaining the appropriate tracer gas release permits, 3) DPG was responsible for the release of any tracer chemical other than SF₆ into the air, including release system design and construction (or modification of existing systems), and actual chemical release, 4) DPG procured all tracer chemicals including SF₆, 5) DPG provided meteorological forecasts and modeling to support the tests, and 6) DPG provided FRD with appropriate office space, laboratory space, and equipment storage facilities.

The statement of work was divided into 5 tasks as follows:

1. SF₆ Preparation

FRD will prepare, calibrate, and test the SF₆ release mechanism. The release mechanism will include a multi-bottle release capability to permit the continuous, uninterrupted release of SF₆ for four hours. The release mechanism will also include the capability to electronically record release rates.

2. Mobile SF₆ Monitoring

FRD will provide two mobile SF₆ analyzers to determine the location and concentration of the SF₆ plume in real-time. Each analyzer will be placed in a vehicle equipped with a GPS receiver and cell phone. Plume locations and approximate concentrations will be provided verbally to the control center as they are acquired. Upon completion of field deployment, data will be provided that show SF₆ plume concentrations and analyzer locations.

3. Whole-air Sampling (optional)

Choice #1 (Programmable Stationary SF₆ Bag Samplers):

FRD will install and maintain a whole-air SF₆ bag sampler at each AFTAC air sampler location and provide duplicate, control, and blank samples for quality control purposes. Each programmable sampler will be equipped with 12 bags for sampling SF₆ for each of the tests. The sampler will be programmed to begin sampling at the same start time as the collocated AFTAC air sampler and continue sampling until the AFTAC air sampler is turned off. It is suggested that each bag be programmed to collect a 20 to 30-minute sample, but this can be adjusted as needed for longer or shorter plume transport distances. The samples will be retrieved after each test and analyzed in a state-of-the-art sample analysis facility at the FRD home office.

Choice #2 (Stationary Real-time SF₆ Plume Analyzers):

FRD will provide two stationary real-time SF₆ analyzers to be collocated with two of the AFTAC samplers near the plume center line. These will be used to determine the total integrated concentration of SF₆, similar to that which will be obtained from the AFTAC samplers. Each analyzer will be placed in a van equipped with a GPS receiver and cell phone. Plume concentrations will periodically be provided verbally to the control center as they are acquired. Upon completion of field deployment, data will be provided on SF₆ plume concentrations and analyzer locations.

4. Stack Release

FRD will provide the labor to operate the SF₆ release mechanism for eight tests in the three-week deployment period.

5. Progress Reporting

FRD will provide status reports of progress and fund expenditures every month beginning with the month in which funding has been secured and continuing until all tasks have been completed. FRD will provide a final report upon completion of all tasks with an appropriate data summary.

Deliverables include the following:

1. Plume Location Data from Mobile SF₆ Detectors (Final Report)
2. Monthly Progress and Funds Expenditure Report

Task 3 (an option) was not funded and is not reported here. After further discussion, an additional mobile analyzer was added to Task 2 for deployment to Dugway during GAUNTLET. All other tasks were completed and are reported in this document.

An additional task was added to support Divine Umpire. The statement of work read as follows: Deploy one mobile SF₆ analyzer. FRD will provide one mobile SF₆ analyzer to determine the location and concentration of the SF₆ puff in real-time. The analyzer will be placed in a vehicle equipped with a GPS receiver and cell phone. Puff locations and approximate concentrations will be provided verbally to the control center as they are acquired. Upon completion of field deployment, data will be provided that show SF₆ plume concentrations and analyzer locations.

The additional Divine Umpire task was eventually cancelled, although significant progress had been made prior to cancellation including complete preparation for field deployment. However, no data was acquired and no data report will be issued on the Divine Umpire project.

This final report consists of several sections. Plume location data, found in the Appendix, is the required deliverable as specified by the statement of work. The other sections contain

information useful to the documentation of the experiment and are provided at no additional cost to the sponsor.

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SF₆ TRACER RELEASE SYSTEM

The SF₆ release mechanism was custom-built for the GAUNTLET program at the FRD offices in Idaho Falls, ID. The system was built on wheels so that it could be moved with the new mobile DPG release stack facility. The system was transported to DPG at the beginning of the field deployment and attached to the DPG release stack. The system was entirely self-contained and required only 115 VAC and a port access into the DPG release stack.

The heart of the system was a computer-controlled mass flow controller. The system included both digital and analog output as well as computer and manual controls. Flow rates from the mass flow controller and weight change as measured by load cells attached to each SF₆ cylinder were continuously monitored and recorded with a data logger. Total SF₆ weight loss for each test was determined using the beginning and ending weights of all SF₆ cylinders using the load cells. A schematic of the release mechanism is shown in Figure 1. Photos of the release mechanism are shown in Figures 2 and 3. The general flow of the SF₆ was from the storage bottles into the mass flow controller, through the visible flow meter, and into the heated air stream of the release stack. The release system was designed to release SF₆ as a gas. Therefore, heater bands were placed around the SF₆ cylinders to convert the liquid SF₆ to gaseous SF₆ before it left the cylinders and entered the control and measurement portions of the mechanism. The system was designed to release SF₆ at a rate of 70 kg hr⁻¹, but this rate could be adjusted from 10 to 150 kg hr⁻¹.

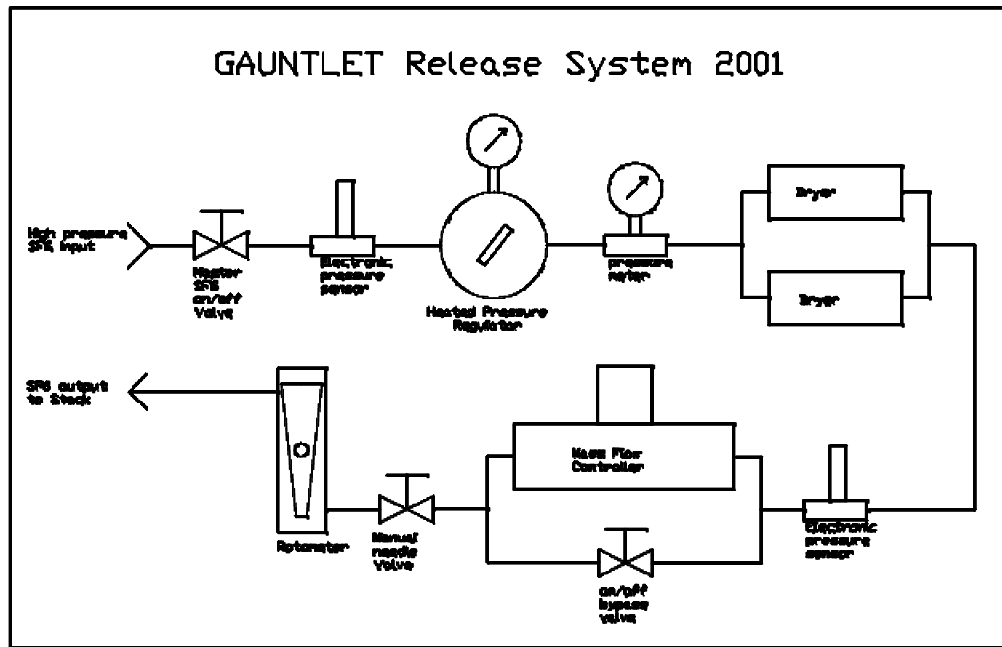


Figure 1. Schematic representation of the mobile SF₆ release mechanism.



Figure 2. Mobile SF₆ release mechanism showing SF₆ bottles suspended from load cells in the white bottle rack. The mass flow controller and data logger are in the back of a 3/4 ton van that is parked next to the rack during active tracer releases. The mobile DPG stack is in the background.

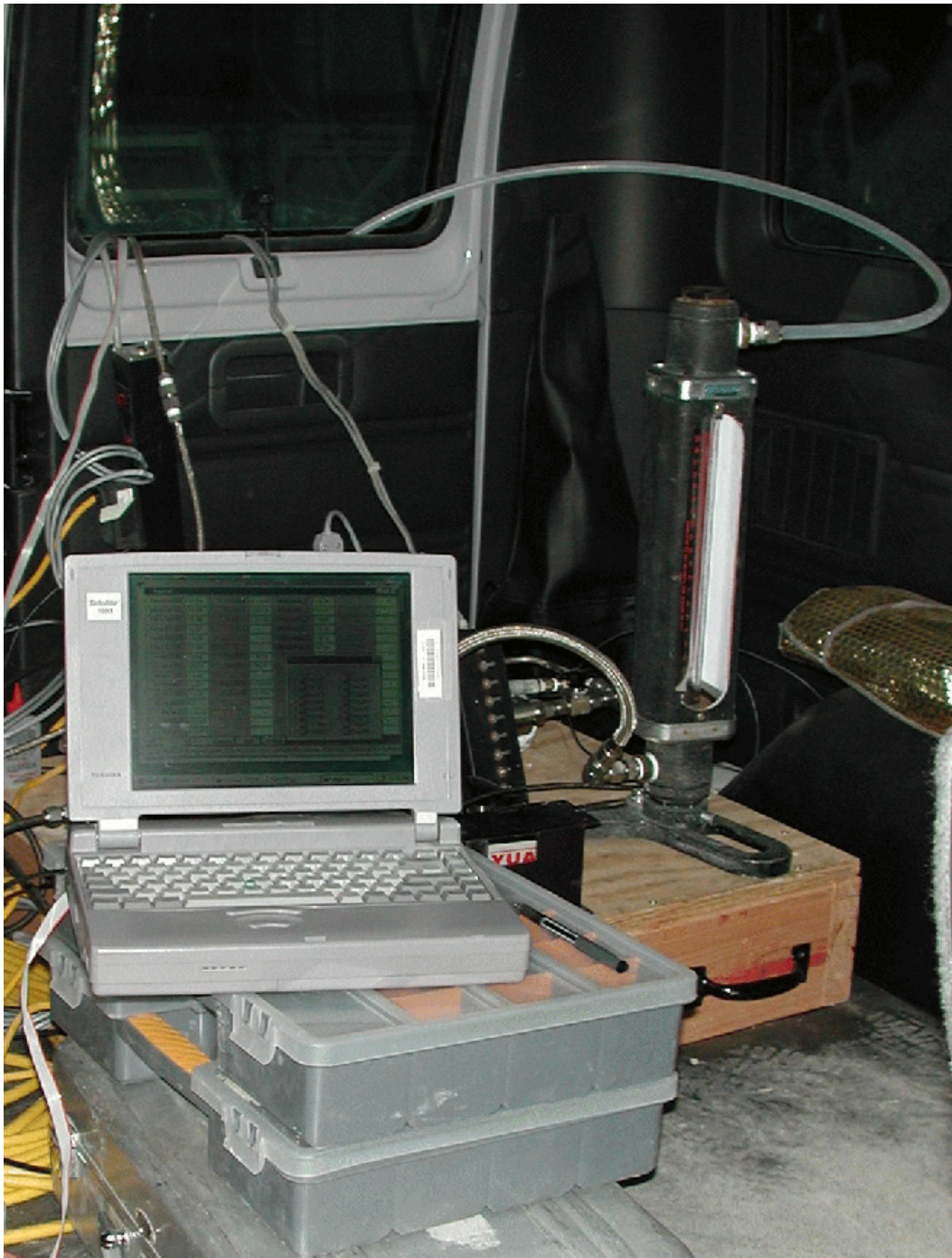


Figure 3. SF₆ release mechanism housed in the rear of a 3/4 ton van, showing the computer-controlled mass flow controller, visible flow meter, and data logger.

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SF₆ TRACER ANALYSIS SYSTEM

Continuous SF₆ concentration measurements were made using a FRD-built mobile analysis system shown in Figure 4. The real-time SF₆ analyzers are vehicle mounted systems that make measurements of atmospheric SF₆ concentrations with a response time of just under one second (Benner and Lamb, 1985). The rapid response time and mobile nature of the analyzers make them ideally suited for measurements of plume widths and structure. They have been utilized in experiments measuring both across wind and along wind diffusion parameters commonly used in transport and dispersion models and Gaussian plume models. The heart of the system is the TGA-4000 (Tracer Gas Analyzer) manufactured by Scientech Inc. of Pullman, Washington. It also includes a computer-controlled calibration system and an integrated global positioning system (GPS) that tags each point with sampling time and location. Run time quality control (QC) outputs allow operators to monitor the performance of the system. The TGA instrument is described in detail elsewhere (Watson et al., 1998), but has since been modified for greater mobility. A schematic representation of the system is shown in Figure 5.

The TGA-4000 real-time SF₆ analyzer is a fast response instrument designed specifically to measure the concentration of SF₆ in ambient air. The TGA-4000 uses an electron capture detector (ECD) to detect SF₆. The ECD is very sensitive to halogenated compounds such as



Figure 4. NOAA continuous mobile SF₆ tracer gas analysis system installed in the rear seat of an SUV, showing computer controlled TGA-4000 (bottom) and calibration gas container (lower right).

chloro-fluorocarbons and SF₆ as well as oxygen. Oxygen interferes with the ECD operation and is, therefore, removed from the sample prior to introducing it into the ECD. This is done by reacting the oxygen with hydrogen in a catalytic reactor and removing the resultant water with a semi-permeable membrane. The detection limit of the ECD is about 5 parts per trillion volume (pptv). The maximum concentration is about 10,000 pptv, but can be doubled with the aid of a dilution system.

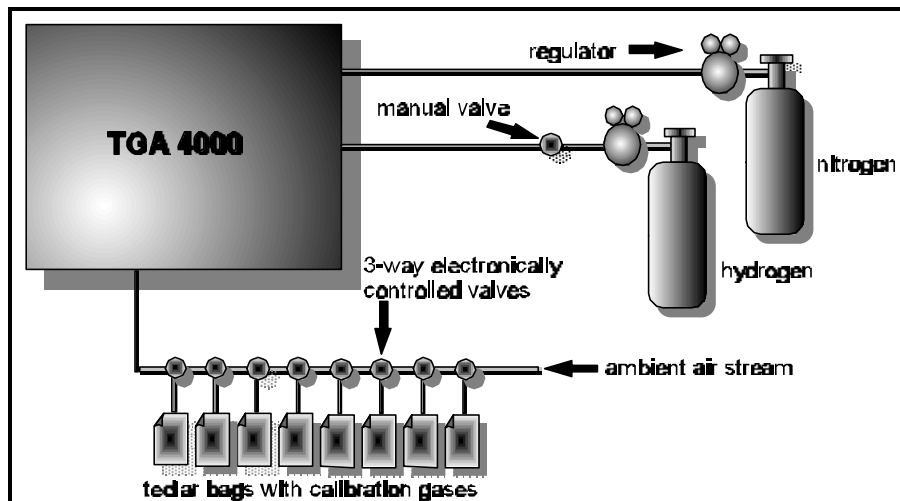


Figure 5. Schematic representation of the NOAA continuous SF₆ tracer gas analyzer.

The TGA-4000 signal along with real-time GPS position, instrument temperatures, and ambient pressure are collected by a laptop computer at the rate of 2 Hz. The computer stores the data for later post-processing and simultaneously displays the TGA-4000 signal for operator interpretation and control. Using this display, the operator determines the plume concentration and position by using software controls to “mark” the beginning and ending of the plume trace. The operator can then communicate this information via wireless means to personnel directing the test.

CALIBRATION

The SF₆ analysis system incorporates a calibration facility for real-time mobile calibration of the TGA-4000. Calibration of the instrument is accomplished by allowing it to sample calibration mixtures with known concentrations of SF₆ and recording the output corresponding to each concentration. SF₆ concentrations of sample air are then determined by linearly interpolating between the calibration concentrations whose output values bracket the TGA-4000 output. Eight calibration standards are used, usually ranging in concentration from pure air to about 5,000 pptv. For the GAUNTLET program, the calibration gas concentrations ranged from 0 to 2915 pptv SF₆, but Sampling Units A and B used a 0 to 5100 pptv SF₆ range on tests 4 through 7. During Test 7, Sampling Unit A used a dilution system for some of the plume traverses which diluted the incoming sample with an equal amount of ultra-pure air. This action reduced the SF₆ concentration in the analyzer to ½ of the sample concentration. The reduced concentration was then measured and the result multiplied by 2 to yield the sample concentration. This allowed Sampling Unit A to measure concentrations up to 10,200 pptv (twice the highest calibration) without extrapolating beyond the calibration curve. Concentrations more than 10% above the highest calibration standard (2915 ppt or 5100 ppt) must be regarded as having a higher degree of uncertainty because their concentrations were calculated by extrapolating beyond the calibration curve rather than

interpolating between calibrations. A full set of eight calibrations was run on each analyzer before the release and after sampling was completed. Operators also ran calibration verification sets during the tests as needed.

Two quantities that are useful for evaluating instrument performance are the limit of detection (LOD) and the limit of quantitation (LOQ). The LOD is the lowest concentration level that can be determined to be statistically different from a blank or a 0 pptv SF₆ sample (Keith et. al., 1983). The LOQ is typically defined to be the level at which the concentration may be determined with an accuracy of $\pm 30\%$. The recommended values for these are 3F for LOD and 10F for LOQ, where F is the standard deviation for measurements made on blanks or low standards (Keith et. al., 1983). Since the TGA-4000 is measuring continuously, every point may be viewed as a measurement of a blank so long as the TGA-4000 is sampling clean air. F then becomes the standard deviation of the TGA-4000 baseline signal. As part of the start up procedure, the operators calculated this value before every test. The results are summarized in Table 1. Typically, peaks with maximum concentrations below the LOD are not reported. Concentrations below the LOQ should be viewed as less certain.

Table 1. Limit of detection (LOD) and limit of quantitation (LOQ) values in pptv for the real-time analyzers calculated from baseline variations.

Test	LOD			LOQ		
	Unit A	Unit B	Unit C	Unit A	Unit B	Unit C
1	7	7	7	25	23	25
2	8	3	6	25	10	21
3	6	3	6	19	9	21
4	6	4	6	21	12	19
5	6	3	6	19	10	20
6	7	3	not used	24	11	not used
7	6	4	not used	21	12	not used
Average	7	4	6	22	13	21

An alternative method of calculating LOD and LOQ is to look at the variation in the determined concentration for a low concentration standard (Keith et. al., 1983). By treating calibrations with the 31.6 pptv standard as unknowns and determining their concentration, this method may be applied to the real-time analyzers. Determining the concentration requires that the baseline voltage level be subtracted off of each calibration just as is done for plume crossings. Since this method more closely approximates the calculations done on the actual data, it may be a better indicator of method LOD and LOQ. A total of 69 calibrations were made with the 31.6 pptv

standard on all three analyzers during the study. Including all of these in the calculation yields a method LOD of 7.6 pptv and a method LOQ of 25.2 pptv.

To determine the overall accuracy and precision of the real-time analyzer measurements, calibrated analyzers were allowed to sample gas mixtures with known SF₆ concentration. The percent recovery (i.e., 100% multiplied by the measured concentration divided by the actual concentration) for each test was recorded. Ninety-seven tests were made and are summarized in Table 2. These tests were made over a period of two months on multiple analyzers. Most were made in the laboratory, but some were made with the analyzers mounted in minivans. The test conditions were designed to mimic the actual field operations as closely as possible. The calibration procedures were exactly the same as those used in the field and the times between calibration and test varied from a few minutes to several hours, just as they do in actual operations. Measurements were made both with and without the dilution system operating. The sampled mixtures were not the same as the calibration mixtures.

Since both the calibration mixtures and the sampled mixtures were listed by the manufacturer as $\pm 5\%$, it is reasonable to expect accuracy variations up to $\pm 10\%$. All of the average recovery values are within this range. The standard deviations for all of the groups reported were less than 8.7%, which should be a reasonable estimate of precision for this study. From this, we conclude that the 95% confidence intervals for the analyzer measurements are $\pm 17\%$.

Table 2. Percent recovery of SF₆ concentrations by real-time analyzers sampling known mixtures as unknowns.

SF ₆ concentration (pptv)	average recovery (%)	standard deviation (%)	number of trials
514	98	8.65	20
2065	110	4.06	17
2087	105	6.68	15
2065 and 2087 combined	107	5.91	32
4095	101	8.69	45
all samples	103	8.65	97

QUALITY CONTROL

The quality control (QC) procedures for the real-time analyzers consists of four steps that are described in detail below:

1. Monitoring of key operational parameters of each analyzer during the study to insure that problems are detected and corrected before they affect measurements.
2. Real-time monitoring of analyzer calibration recoveries during each test.
3. Post processing review of all calibrations to insure that they meet performance criteria.
4. Review of all operator-marked plume crossings.

Monitoring of key operational parameters

Analyzer operators fill out a Settings Record as they run the real-time analyzers. They record 17 instrument parameters at key times during the operation. These include gas pressures, flow rates, temperatures, electrometer settings, etc. The Settings Record, constructed in table form, contains several days of entries. These sheets are reviewed for any large changes in the parameters that could indicate a problem with the analyzer. Any changes are investigated and required maintenance is performed.

Real-time monitoring of recoveries

During measurement operations, single calibrations are periodically run on the analyzers. The software on the analyzer treats these calibrations as unknowns and calculates their concentration based on the first set of calibrations performed during the test. If the calculated concentration has changed more than 20% since the previous complete calibration set, a new complete set of calibrations is immediately run. This insures that measurements are not made with a calibration curve that doesn't reflect the current instrument operation.

Post processing review of calibrations

After a test is completed, the calibrations from each analyzer are carefully reviewed. Any calibrations with problems such as significant baseline drift, contamination, accidental instrument adjustments, etc., are identified and eliminated from the group. The calibrations are then treated as unknowns and the concentrations calculated based on both the first set of calibrations and all of the calibrations averaged together. The recovery for each calibration is calculated ($100\% \times \text{calculated concentration} / \text{actual concentration}$) and printed on a QC sheet.

The recoveries are required to be within 20% of the actual concentration and the RMS error for the calibration curve must be less than 10% of the midpoint concentration on the curve. If these criteria are not met, and a sufficient number calibration sets exists, the calibrations may be broken into two or more groups representing different periods of time. Typically, an "early" set and a "late" set is used. If these groups meet the criteria, each group is used to calculate concentrations for plume crossings within the time frame they encompass. Any re-grouping or changes to the calibrations are noted on the QC sheet. All QC sheets are reviewed by two people

to make sure that errors are not missed and all changes are appropriate. If the criteria can not be met, the plume concentrations for that analyzer will be labeled as "estimates" for that test. For the GAUNTLET study, all analyzer calibrations met the criteria.

Review of operator marked plume crossings

Analyzer operators identify SF₆ plume crossings and mark them on the computer screen using computer function keys. They also record details of each plume crossing, e.g., time, concentration, latitude and longitude, together with other pertinent observations in a notebook. After a test, the marked plumes are compared with the notebook to ensure that marked plumes were above the LOD and that they were not false peaks caused by extraneous factors such as altitude changes, bumps, interfering chemicals in the air, etc. The plume crossings are checked for correct identification of instrument baseline on leading and trailing sides of each peak. The entire data set is examined for possible plume crossings that may have been missed. Once necessary corrections are made, the plume crossings are converted to concentrations and placed in separate files. They are then plotted and examined by two people for possible errors.

FIELD DEPLOYMENT

The full-scale field deployment began on 02 April 2001, when the FRD crew began to arrive at DPG. Prior to our arrival, all preparations had been completed including rebuilding, refurbishing and testing the SF₆ release mechanism, and testing, calibrating and installing the mobile SF₆ real-time analyzers in three sport utility vehicles (SUVs). During the following two days, a calibration and repair facility was established at DPG as well as a temporary office facility. Personnel were briefed on unexploded ordinance, access to the West Desert Test Center where the south release site was located, and on access to the Wendover Bombing Range where the north release site was located. They also became familiar with the SF₆ sampling roads and trails, which are shown in Fig. 6. Additional details of the sampling routes are shown in Fig 7. A 3-dimensional relief map of the area is shown in Figure 8. During these preparations, the mobile

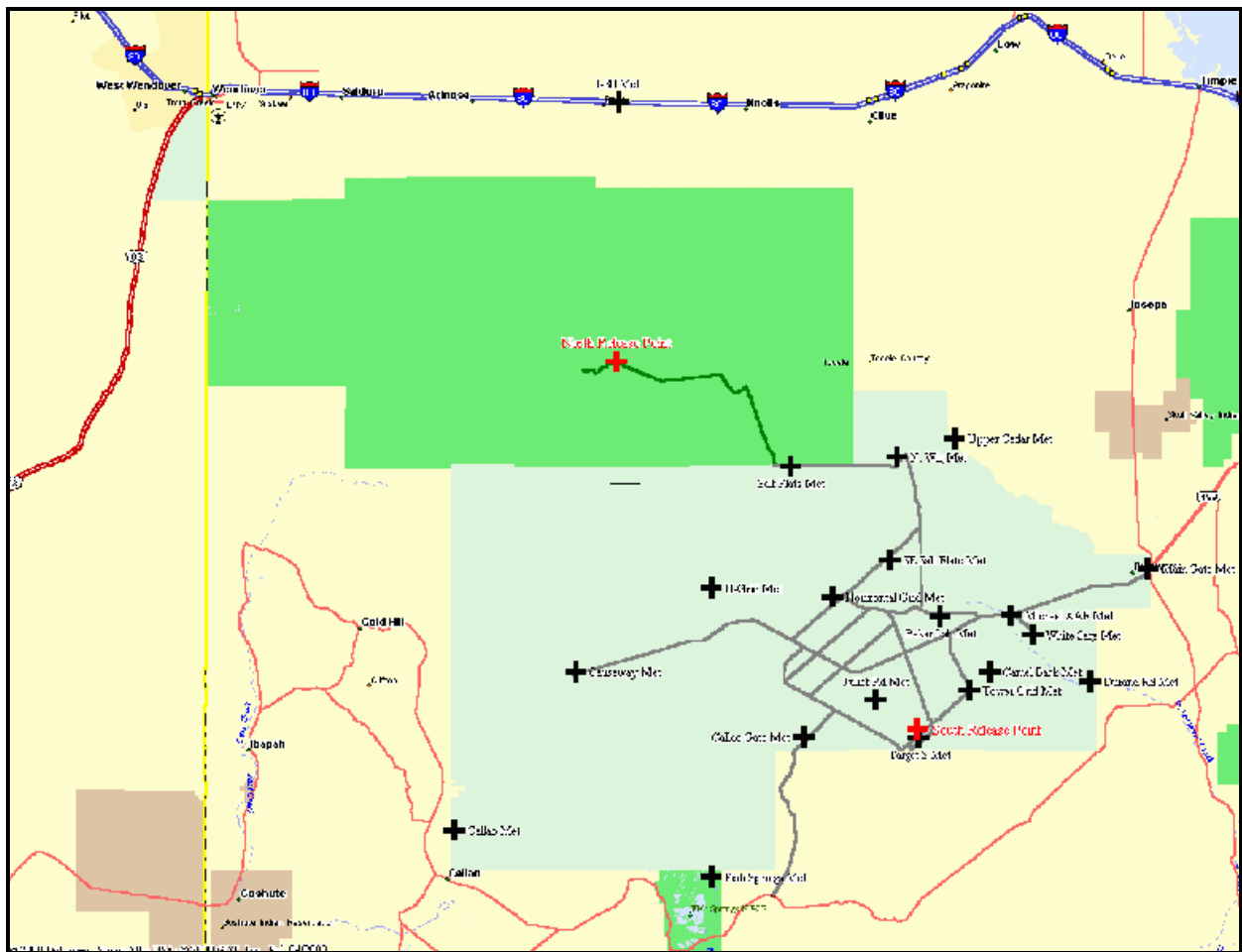


Figure 6. SF₆ sampling domain in west-central Utah, bounded by Interstate 80 (blue, top) and Pony Express Road (bottom, red) extending east from Fish Springs NWR. Also shown are the Dugway Proving Ground (large light-blue polygon), the Wendover Bombing Range (large green polygon), the north tracer and south tracer release sites (red crosses), and the location of the DPG meteorological towers (black crosses). Major DPG sampling roads are shown in gray.

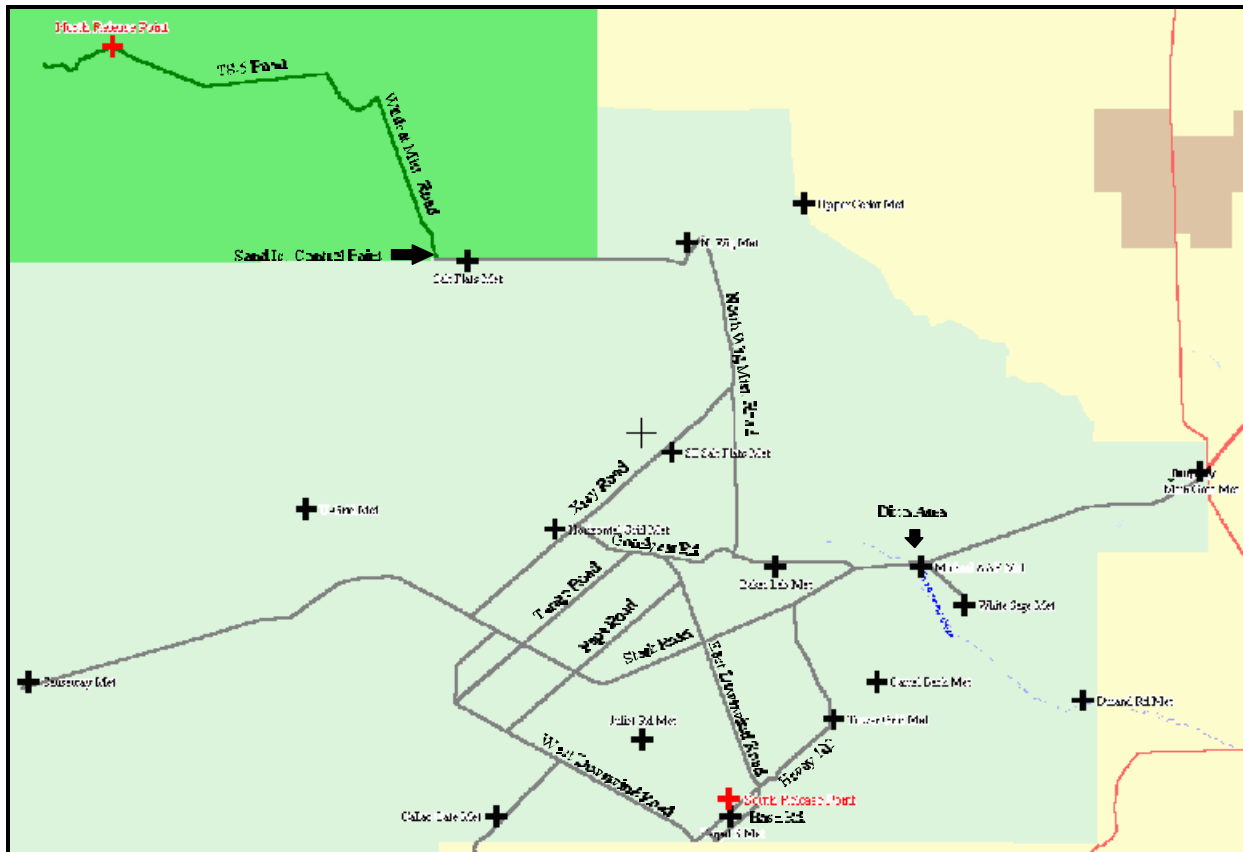


Figure 7. Major DPG and Wendover Bombing Range tracer sampling roads, release sites, and meteorological tower locations.

SF₆ release mechanism was connected to the DPG mobile stack and loaded with SF₆ bottles. Two release sites had been established. The north release site was on the Wendover Bombing Range at a location called TS-5. The south release site was on the Dugway Proving Ground in the Target S Grid area (Figs. 6 and 7). On 04 April 2001, the FRD crew was ready for testing. Background measurements to determine any fugitive SF₆ sources in the DPG area were conducted that day and again on 06 April 2001. SF₆ tracer releases began on 10 April. The deployment ended on 27 April when both the release and sampling crews returned to FRD headquarters in Idaho Falls, ID.

A total of 7 tests were conducted during the deployment. Each test consisted of a 4-hour release of SF₆ tracer into the mobile 21.3-m tall DPG stack, with a simultaneous real-time sampling of the resultant SF₆ plume by mobile analyzers. Flow through the stack was assisted with a DPG-supplied Dash-60 start cart. Plume sampling usually continued up to 4 hours after the release had ended. The plume was usually sampled with three sampling units that traversed the plume along established routes at increasing distances on DPG, on the Wendover Bombing Range, on I-80, or along the Pony Express Road. When the sampler operator determined that the plume had been crossed, he determined the plume width, maximum concentration, and location of the maximum concentration and relayed that information via cell phone and DPG radio to the control point for review by the FRD and GAUNTLET test controllers. Average sampling distances from the north release site were approximately 40 km for Sampling Unit A, 60 km for Unit B, and 75 km

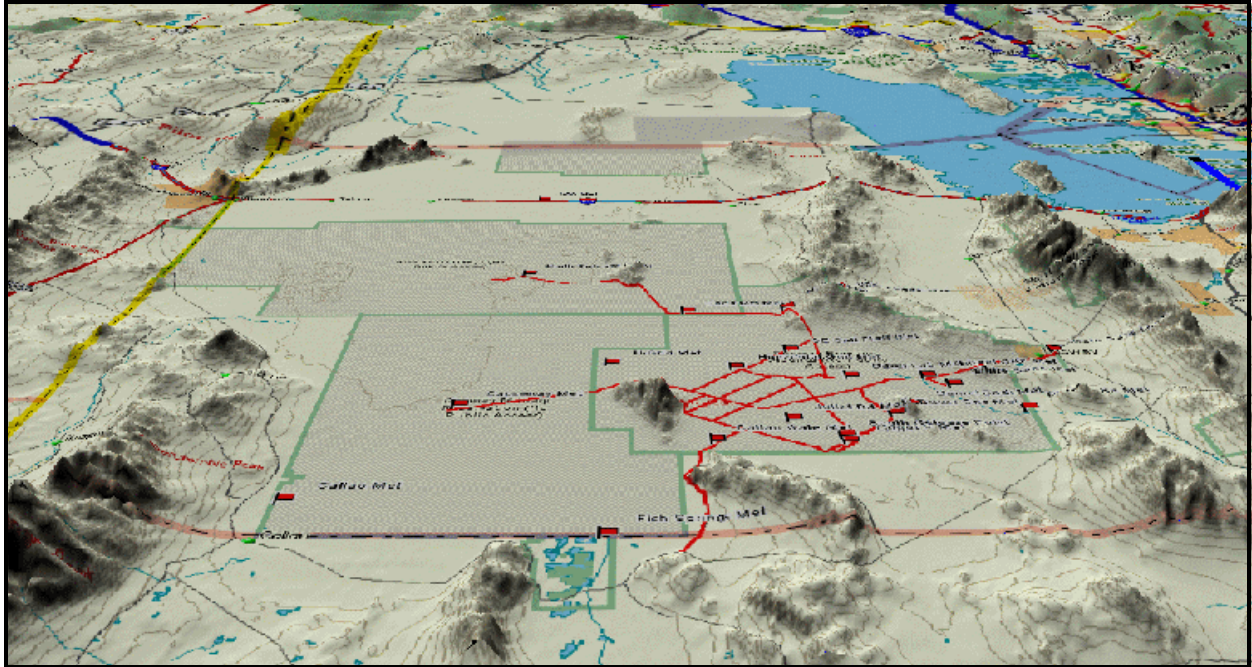


Figure 8. Three-dimensional view of the tracer release and sampling area on DPG and the Wendover Bombing Range, with major DPG sampling roads shown in red (see gray roads in Figs. 6 and 7) and meteorological towers represented by flags. Vertical scale is enhanced 4 times to show detail. Interstate 80 traverses image from left to right in the upper middle. The body of water in the upper right is the Great Salt Lake.

for Unit C. Average sampling distances from the south release site were usually 20 km for Sampling Unit A, 50 km for Unit B, and 75 km for Unit C. During Tests 6 and 7, however, wind conditions were unfavorable for transporting SF₆ out to Unit C; that unit was subsequently not deployed.

A total of 247 sampling traverses were made by the three SUVs. Ninety-three of these traverses resulted in null passes where no SF₆ was detected. One traverse was made during an instrument malfunction. The remaining 153 traverses yielded measurable SF₆ plume concentrations. Sampling Unit A made a total of 116 traverses, Unit B made a total of 58 traverses, and Unit C made 73 total traverses in only 5 tests. Unit B made considerably less traverses than the other units because 1), the roads were much rougher, which required the SUV driver to travel slowly in order to maintain vehicle control, and 2) much of the route was parallel and not perpendicular to the average SF₆ plume, which resulted in longer travel distances. Table 3 contains a summary of the tests, while the following sections describe each test, including the test duration, observed weather conditions, and miscellaneous items of interest. Specific comments relating to tracer release and sampling for each test are also included.

Table 3. Summary of field tests, indicating test number and date of occurrence, location of the SF₆ release, beginning and ending times of SF₆ tracer release and SF₆ sampling, and amount of SF₆ tracer released.

Test Number	Date	SF ₆ Release					SF ₆ Plume Tracking	
		Location	Start Time (MDT)	End Time (MDT)	Total Released (kg)	Average Release Rate (kg hr ⁻¹)	Start Time (MDT)	End Time (MDT)
Back-ground 1	04 April	----	----	----	----	----	1200	1500
Back-ground 2	06 April	----	----	----	----	----	1300	1630
1	10 April	North	1150	1550	286.4	71.6	1150	1740
2	12 April	North	1220	1620	285.9	71.5	1220	1820
3	16 April	South	0100	0500	282.5	70.6	0100	0900
4	16-17 April	South	2300	0300	280.6	70.2	2300	0930
5	17-18 April	South	2200	0152	272.6	70.5	2200	0700
6	24 April	South	0100	0500	281.0	70.3	0100	0830
7	26 April	South	0200	0600	280.5	70.1	0200	1100

Background Sampling Test 1 – 04 April 2001; No SF₆ release

This was the first check for fugitive sources of SF₆ at DPG. Sampling began at 1200 and continued until 1500 hours MDT. Winds were from the north at 2-4 m s⁻¹ for the duration of the test. Thus, the SUV's containing the real-time SF₆ analyzers were deployed at the south end of DPG. Sampling Unit A was deployed on Papa, Tango, and X-Ray Roads, Unit B was deployed on Base Road, and Unit C was deployed on Pony Express Road. Several traverses were made by the three sampling units along their respective sampling routes with the exception of Unit C, which was beset by a flat tire on its initial traverse. No significant amounts of SF₆ were measured during this test.

Background Sampling Test 2 – 06 April 2001; No SF₆ release

This was the second check for fugitive sources of SF₆ at DPG. Sampling began at 1300 and continued until 1630 hours MDT. Winds were from the south and southwest at 1-3 m s⁻¹ for

the duration of the test. The real-time SF₆ analyzers were deployed at the north end of DPG, on the Wendover Bombing Range and farther north. Unit A was deployed on Papa, Tango, and X-Ray Roads, Unit B was deployed on Base Road, Highway 102, and East and West Downwind Roads, and Unit C was deployed on I-80. Unit C did not encounter any SF₆. Unit A encountered an insignificant amount of SF₆ on Stark Road near Granite Mountain. Unit B encountered SF₆ at the release site where preparations for a future release were ongoing. Figure 9 shows the location of these encounters and the maximum concentration of each traverse. As a result of the two background tests, it was determined that DPG had no significant fugitive sources of SF₆.

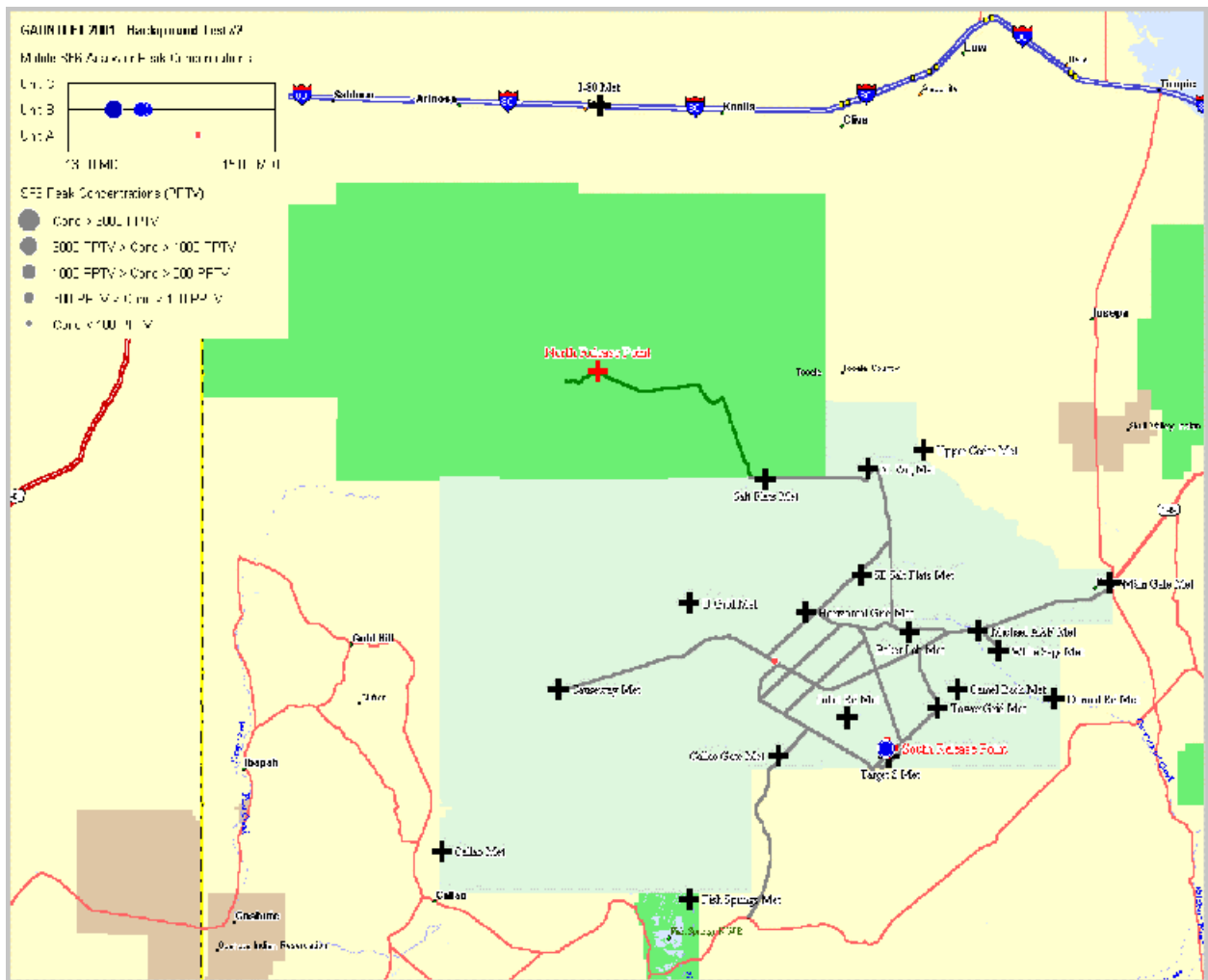


Figure 9. Background Test 2 maximum SF₆ concentration of each plume crossing for Sampling Unit A (red) and Unit B (blue), and time of measurement (upper left). Size of dot increases with increasing concentration. Dots on map indicate the geographical location of each maximum concentration. Color hue changes with increasing time.

Test 1 – 10 April 2001; SF₆ release from 1150-1550 hours MDT

The release was originally scheduled to begin at TS-5 (north release site) at 1000 hours MDT, but was delayed for approximately 2 hours while the DPG crew set up the stack. The release was subsequently begun at 1150 hours under mostly clear skies. The target SF₆ release rate was 70 kg hr⁻¹. Winds were predicted to be out of the north for the duration of the test. Therefore, SF₆ tracking Unit A operated on Goodyear Road west of Granite Mountain, Unit B sampled on Lima Road through Lima Gate to Fish Springs National Wildlife Refuge, and Unit C sampled on Pony Express Road in the area of Fish Springs National Wildlife Refuge.

The release ended at 1550 hours MDT, for a four-hour continuous release of SF₆. A total of 286.4 kg of SF₆ was released, resulting in an average release rate of 71.6 kg hr⁻¹. A graph of the release rate, as measured by the mass flow meter, together with a graph of the cumulative amount of SF₆ released, as measured by the load cells, are shown in Figure 10. The release was conducted without any technical problems.

Skies remained mostly clear and winds remained constant from the north at 6-8 m s⁻¹ for the duration of the test.

SF₆ sampling units continued to traverse the plume until 1740 hours MDT when measurements indicated that the plume had been advected beyond the sampling domain. Sampling Unit A completed a total of 13 traverses along its sampling route. Twelve of these traverses resulted in SF₆ concentration measurements of up to 90 pptv. One traverse was a null crossing, where no SF₆ plume was observed. For Unit B, the values are 9 total traverses, 6 non-null traverses with a maximum concentration of 39 pptv, and 3 null traverses. For Unit C, the values are 11, 4, 33 pptv, and 7, respectively. These data are summarized in Table 4. Figure 11 shows the location of the maximum concentration measured by the mobile analyzers for each pass through the SF₆ plume. As indicated by the map, many plumes were observed in the area west of Granite Mountain and southward in the area of Fish Springs National Wildlife Reserve. All sampling units measured rather low concentrations, caused by the high dispersion characteristics of the atmosphere that is typical of midday conditions. The consistency of the plume center of mass locations from sampling unit to sampling unit indicates a rather consistent wind direction across the sampling domain throughout the entire sampling period.

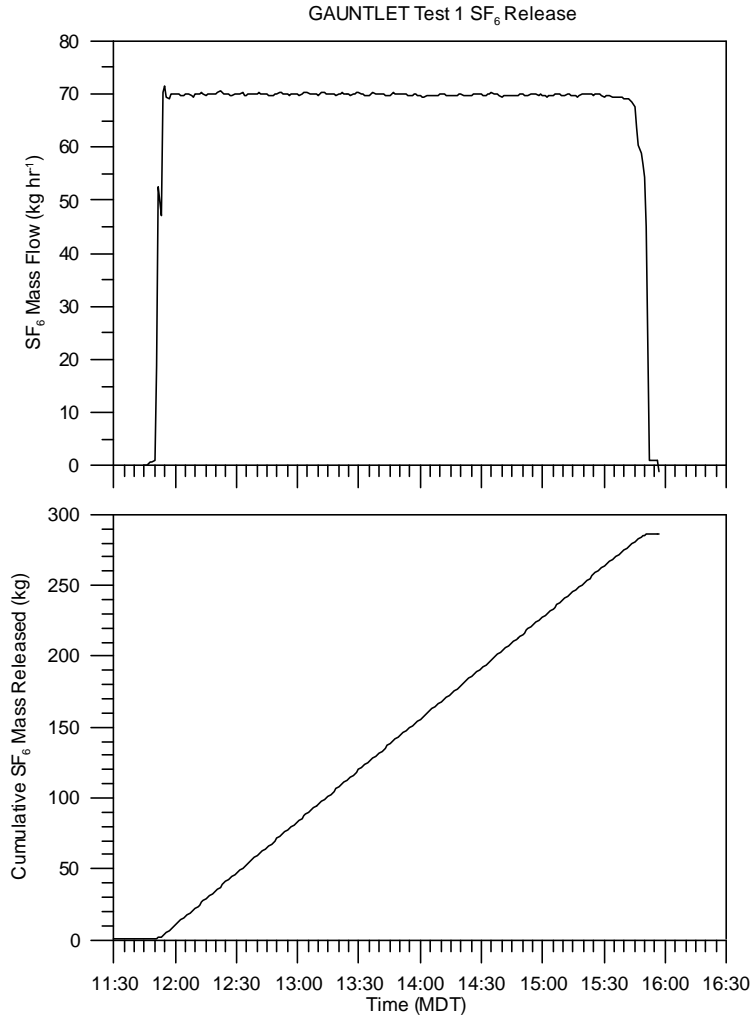


Figure 10. Test 1 SF₆ release rate from the mass flow meter (top) and cumulative mass of SF₆ released from the SF₆ cylinder load cells (bottom).

Table 4. Summary of Test 1 SF₆ sampling unit activity.

Sam-pling Unit	General Sampling Route	Total Number of Traverses	Number of Null Traverses	Number of Non-null Traverses	Maximum Concentration (pptv)	Bearing to Release Site (deg.)	Range to Release Site (km)
A	Goodyear Rd.	13	1	12	90	168	34
B	Lima Rd.	9	3	6	39	169	69
C	Pony	11	7	4	33	167	67

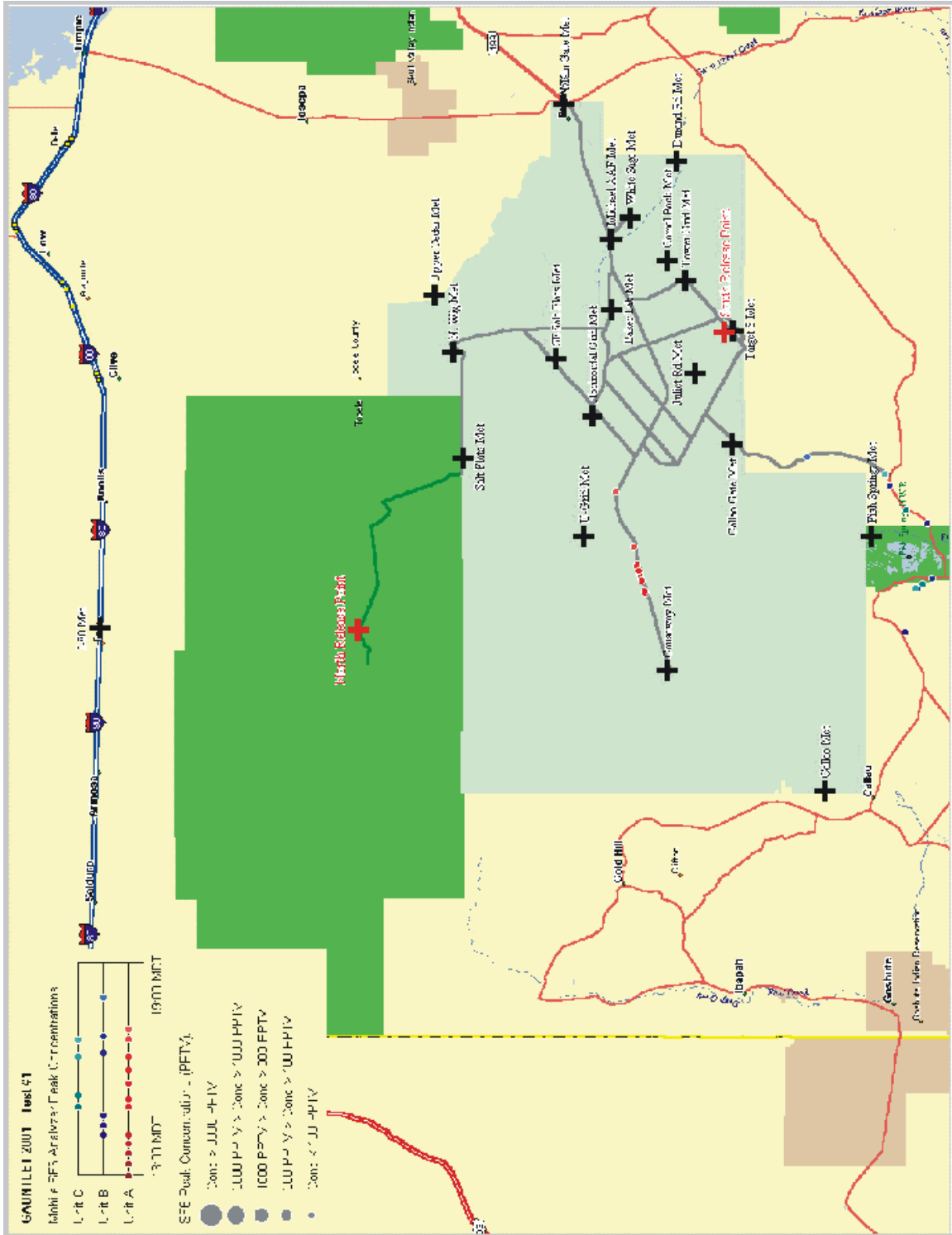


Figure 11. Test 1 maximum SF₆ concentration of each plume crossing for Sampling Unit A (red), Unit B (blue), and Unit C (teal) and time of measurement (upper left). Size of dot increases with increasing concentration. Dots on map indicated the geographical location of each maximum concentration. Color hue changes with increasing time.

Test 2 – 12 April 2001; SF₆ release from 1220-1620 hours MDT

The release was scheduled to begin at 1200 hours MDT at TS-5 (north release site), but it was delayed 20 minutes due to technical difficulties experienced by DPG personnel. The SF₆ release began at 1220 hours MDT at a target rate of 70 kg hr⁻¹ under mostly cloudy skies. Winds were predicted to be from the northwest. SF₆ tracking Unit A was deployed to X-Ray Road, Unit B to Stark Road, and Unit C to Pony Express Road. Note that snow had fallen during the previous night and continued to fall well past 0700 hours MDT, but had melted in most valley locations when testing began.

Winds were continuously from the northwest throughout the test period at about 3-5 m s⁻¹ under very convective conditions. Some showers were observed in the area south and west of DPG. The clouds decreased throughout the test, and skies became partly cloudy by the end of the test.

The release was briefly interrupted at 1335 hours for one minute to remove a one-way valve that prevented the valve on SF₆ cylinder #1 from opening. Had the release not been interrupted, the release would have had to be terminated 40 minutes early because the one-way valve completely prohibited the flow of SF₆ from leaving that one cylinder. The release ended at 1620 hours for a nearly continuous release of 4 hours. A total of 285.9 kg of SF₆ was released, resulting in an average release rate of 71.5 kg hr⁻¹. Figure 12 shows the release rate and the cumulative amount of SF₆ released for the entire test.

The SF₆ plume was tracked from 1220 through 1820 hours when the plume was no longer detected. Sampling unit activity is summarized in Table 5. Sampling Unit A made a total of 18 traverses along its sampling route, and measured the plume 9 times. The maximum plume concentration of all 9 passes was 28 pptv measured at a bearing of 127 degrees and a range of 40 km from the release site. Sampling Unit B made 11 traverses along its sampling route and measured one false peak caused by oxygen breakthrough into the electron capture detector. This problem was quickly detected and repaired for the remainder of the test. The false peak is not included in the data set. Unit C also did not measure any appreciable SF₆ plumes although it made 16 total traverses. The location of the maximum concentration measured by the mobile analyzers for each pass through the SF₆ plume is shown in Figure 13. Most of the plume interceptions were near the intersection of Wig Mountain Rd. and X-Ray Rd. As in Test 1, all plume concentrations were low owing to the highly convective nature of the atmosphere at midday.

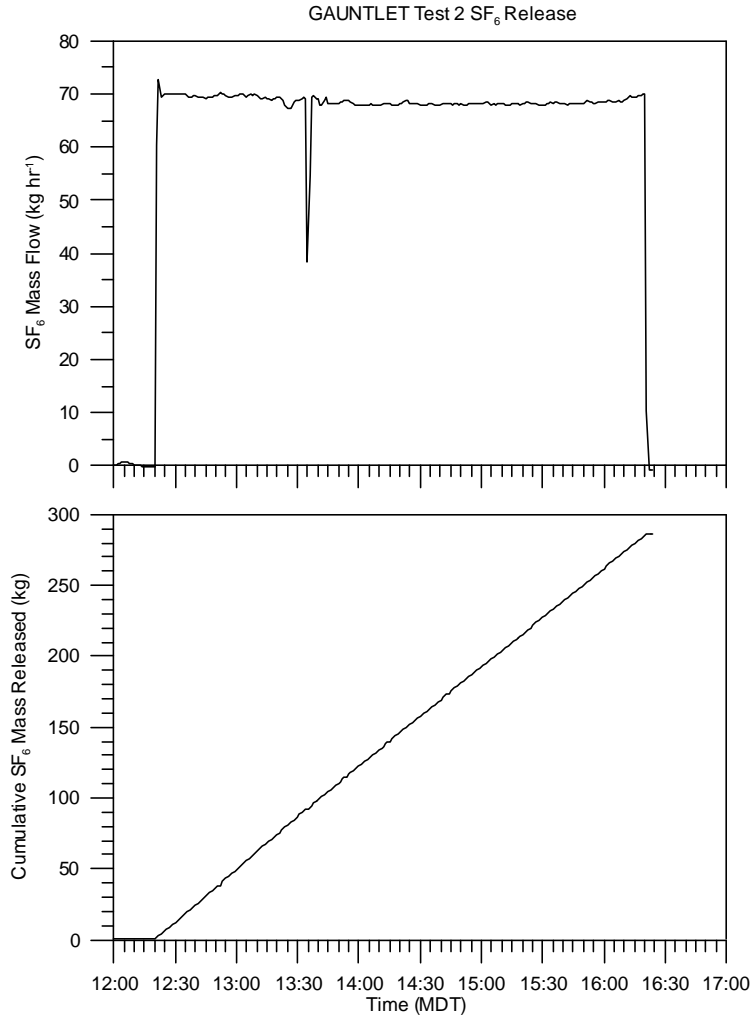


Figure 12. Test 2 SF₆ release rate from the mass flow meter (top) and cumulative mass of SF₆ released from the SF₆ cylinder load cells (bottom).

Table 5. Summary of Test 2 SF₆ sampling unit activity. The single non-null traverse from Unit B is a false peak caused by instrument problems and has been discarded.

Sam-pling Unit	General Sampling Route	Total Number of Traverses	Number of Null Traverses	Number of Non-null Traverses	Maximum Concentration (pptv)	Bearing to Release Site (deg.)	Range to Release Site (km)
A	X-Ray Rd.	18	9	9	28	127	40
B	Stark Rd.	11	10	1	----	----	----
C	Pony	16	16	0	----	----	----

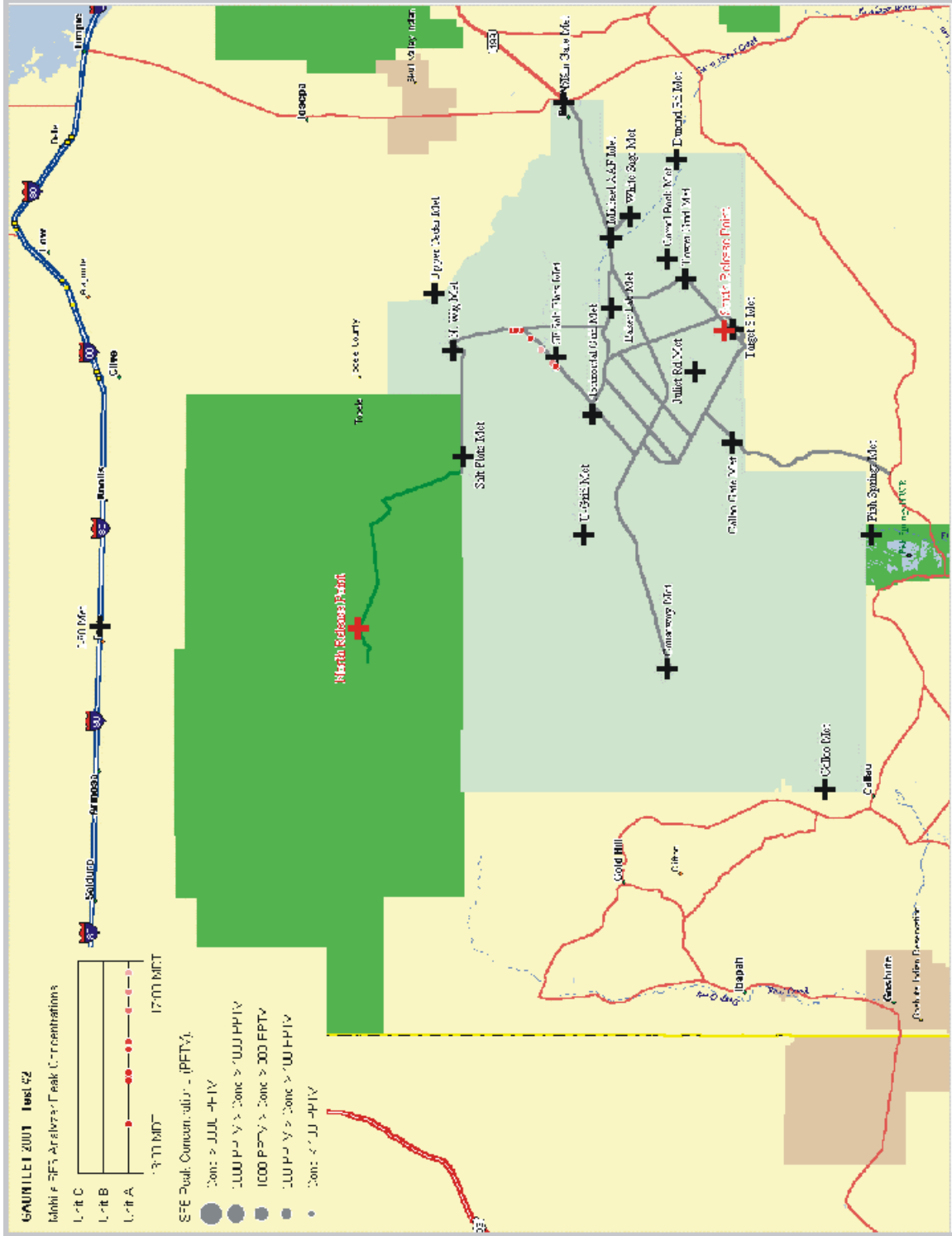


Figure 13. Test 2 maximum SF₆ concentration of each plume crossing for Sampling Unit A (red) and time of measurement (upper left). Size of dot increases with increasing concentration. Dots on map indicate the geographical location of each maximum concentration. Color hue changes with increasing time.

Test 3 – 16 April 2001; SF₆ Release from 0100-0500 hours MDT

The release was scheduled to begin at 0000 hours MDT at Target S Grid (south release point). Light southeasterly winds were forecast to occur during the test. However, the winds did not set up in the appropriate direction at Target S and a 1-hour delay was instituted. The release subsequently began at 0100 hours at a target rate of 70 kg hr⁻¹ under clear skies and light southeast winds. Sampling Units A, B, and C were deployed initially to Tango Road, TS-5 Road, and I-80, respectively.

Skies remained clear throughout the test and the winds at Target S remained out of the southeast at 2-3 m s⁻¹. However, the winds at TS-5 and I-80 remained northwesterly at 1-2 m s⁻¹ for the duration of the test and necessitated revising the sampling unit routes. Sampling Unit A was reassigned to sample on X-Ray Road, while Unit B was reassigned to sample on Wig Mountain Road from Sand Island Control Point eastward.

The release was terminated as scheduled at 0500 hours MDT, resulting in a 4-hour release. A total of 282.5 kg of SF₆ was released at an average rate of 70.6 kg hr⁻¹. Figure 14 shows the release rate and the cumulative amount of SF₆ released for the entire test.

The sampling units were active from 0100 through approximately 0900 hours MDT. Sampling unit activity is summarized in Table 6. A total of 38 traverses were made during the test by the sampling units. A combined map/graph of the maximum plume concentration for each plume traverse and the location of those concentrations is shown in Figure 15. Sampling Unit A completed a total of 18 traverses and measured SF₆ on 17 traverses, with a maximum concentration of 6714 pptv at a distance of 19 km from the release site. The SF₆ concentrations in Plumes 5 and 7 were so high that they over-ranged the instrument, which resulted in a flat-topped peak. In addition, SF₆ concentrations in Plumes 2, 8-12, and 16 were more than 10% above the highest calibration gas, making their concentration values less certain. Many of the plumes were centered near the Horizontal Grid Met Tower. Sampling Unit B completed a total of 11 traverses and sampled the plume on 9 of those traverses. Unit B measured a maximum concentration of 6469 pptv 33 km from the release site. The Unit B instrument also over-ranged on Plume 5 and the SF₆ concentrations in Plume 6 were above the highest calibration gas. Many of the plumes measured by Unit B were centered at the Sand Island Control Point. Unit C completed a total of 9 traverses but did not detect any SF₆. The reason for this was clearly the wind direction at the I-80 met station, which indicated northwest winds throughout the duration of the test. The maximum concentrations of this test were much higher than the previous two tests, and were the highest of all the tests except for one plume in Test 7, because of the strong stability of the nocturnal atmosphere.

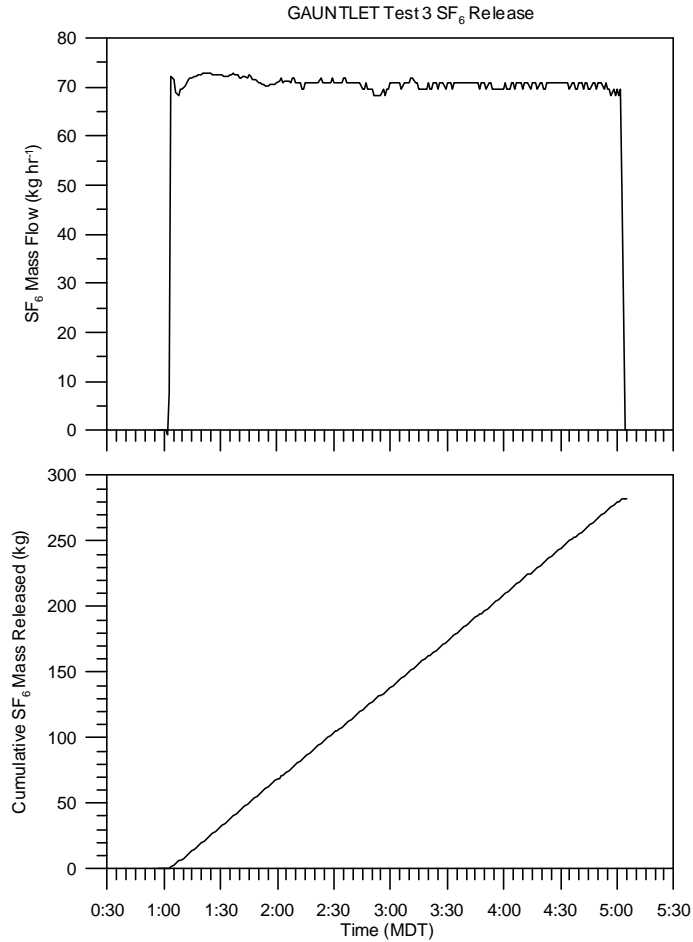


Figure 14. Test 3 SF₆ release rate from the mass flow meter (top) and cumulative mass of SF₆ released from the SF₆ cylinder load cells (bottom).

Table 6. Summary of Test 3 SF₆ sampling unit activity.

Sam-pling Unit	General Sampling Route	Total Number of Traverses	Number of Null Traverses	Number of Non-null Traverses	Maximum Concentration (pptv)	Bearing to Release Site (deg.)	Range to Release Site (km)
A	Tango & X-Ray Rds.	18	1	17	6714	339	19
B	TS-5 & Wig Mtn. Rds.	11	2	9	6469	341	33
C	I-80	9	9	0	----	----	----

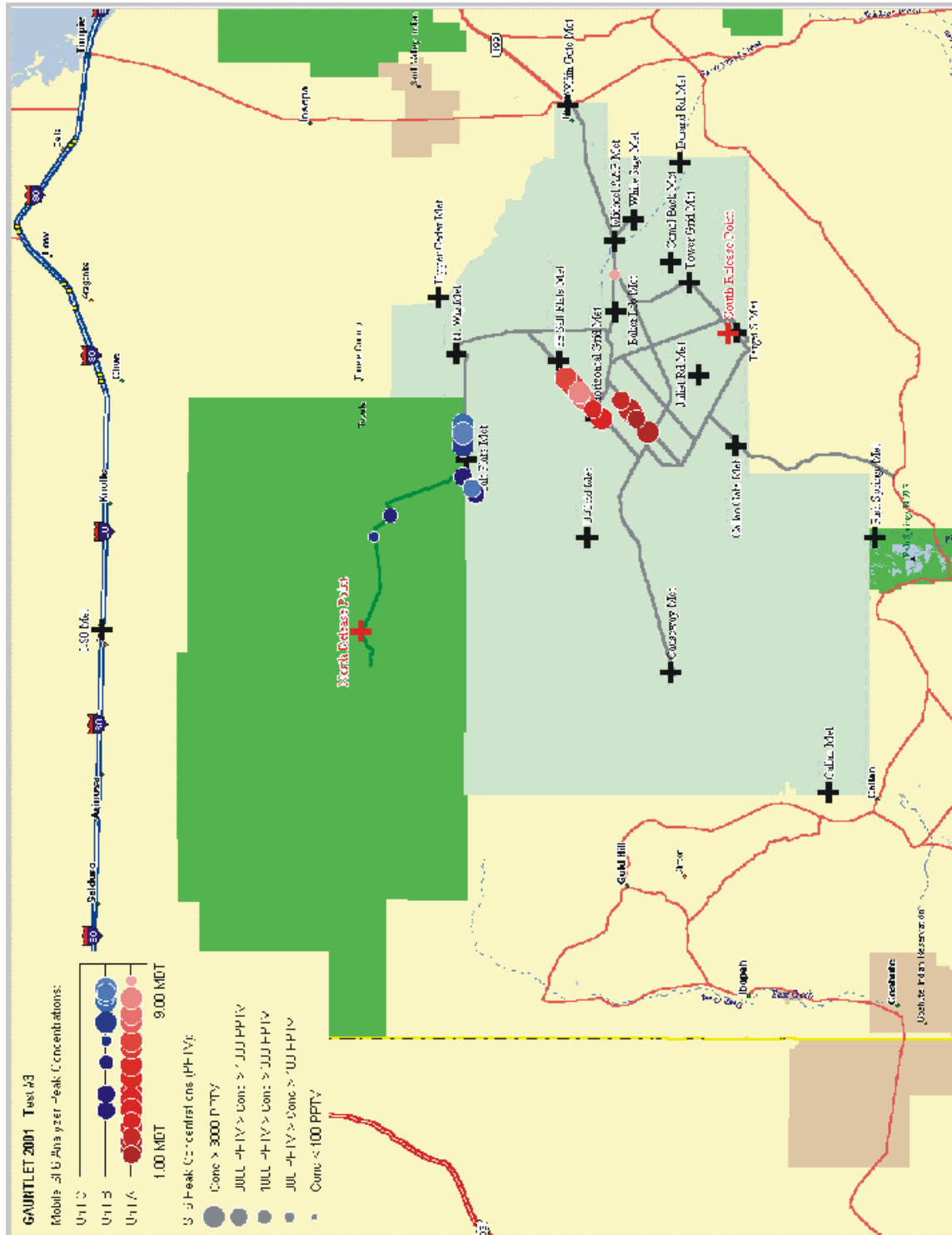


Figure 15. Test 3 maximum SF₆ concentration of each plume crossing for Sampling Unit A (red) and Unit B (blue), and time of measurement (upper left). Size of dot increases with increasing concentration. Dots on map indicate the geographical location of each maximum concentration. Color hue changes with increasing time.

Test 4 – 16-17 April 2001; SF₆ Release from 2300-0300 hours MDT

The release was originally scheduled to begin at 2200 hours MDT at the south release site (Target S Grid) with forecast winds similar to Test 3, but with a more easterly component. However, the winds did not set up in the appropriate direction at Target S until 2300 hours MDT, when the release was started at an intended rate of 70 kg hr⁻¹. Skies were clear and winds were 3 m s⁻¹ from the southeast at Target S Grid. Sampling Units A, B, and C were deployed initially to Tango Road, TS-5 Road, and I-80, respectively.

Skies remained clear throughout the test. The nocturnal inversion did not develop strongly and the result was that the winds at Target S Grid meandered somewhat, maintaining a general southeasterly direction with some excursions from the south and east. Wind speeds were sometimes light and variable, but usually 3-7 m s⁻¹.

During the course of the release, the data logger battery failed. This resulted in a loss of electronically recorded release data from 0135 through 0146 hours MDT. When the problem was discovered, the data logger was quickly repaired and electronic recording continued. This problem did not affect the release in any adverse manner, because the flow rate was maintained manually by the release operator. The release was terminated as scheduled at 0300 hours MDT, resulting in a 4-hour release. A total of 280.6 kg of SF₆ was released at an average rate of 70.2 kg hr⁻¹. Figure 16 shows the release rate and the cumulative amount of SF₆ released for the entire test.

The sampling units were active from 2300 through approximately 0930 hours MDT. A total of 43 traverses were made during the test by the sampling units. Sampling unit activity is summarized in Table 7. A combined map/graph of the maximum plume concentration for each plume traverse and the location of those concentrations is shown in Figure 17. Sampling Unit A completed a total of 18 traverses, 15 of which yielded plume concentrations up to 5028 pptv. Many of the detected plumes were located near the intersection of Stark and X-Ray Roads. Sampling Unit B completed a total of 11 traverses, 6 of which yielded plume concentrations up to 366 pptv. Most of the plumes were measured by Unit B between TS-5 and Wildcat Mountain. Unit C completed a total of 14 traverses, 10 of which yielded plume concentrations up to 96 pptv. Most of the non-null plumes made by this unit were located near the Knolls exit on I-80. Sampling Unit C exhibited some minor difficulties while measuring Plume 6. After completion of the test it became apparent that the plume was widely spread, much larger than the operator had determined during the test. As a consequence, a couple of intermediate calibration spans were conducted while the analyzer was in the plume. Thus, the trace of the SF₆ plume concentration contains these artifacts and is about 2 hours in duration. The bearings at which the maximum plume concentrations were measured changed with increasing distance from the release site. This indicated that the majority of the tracer material was probably transported west of the TS-5 site and then north to I-80 in a curvilinear pattern under increasingly westerly winds. Although this was a nocturnal test, the concentrations were much lower than Test 3 because of the apparent lack of a strong inversion.

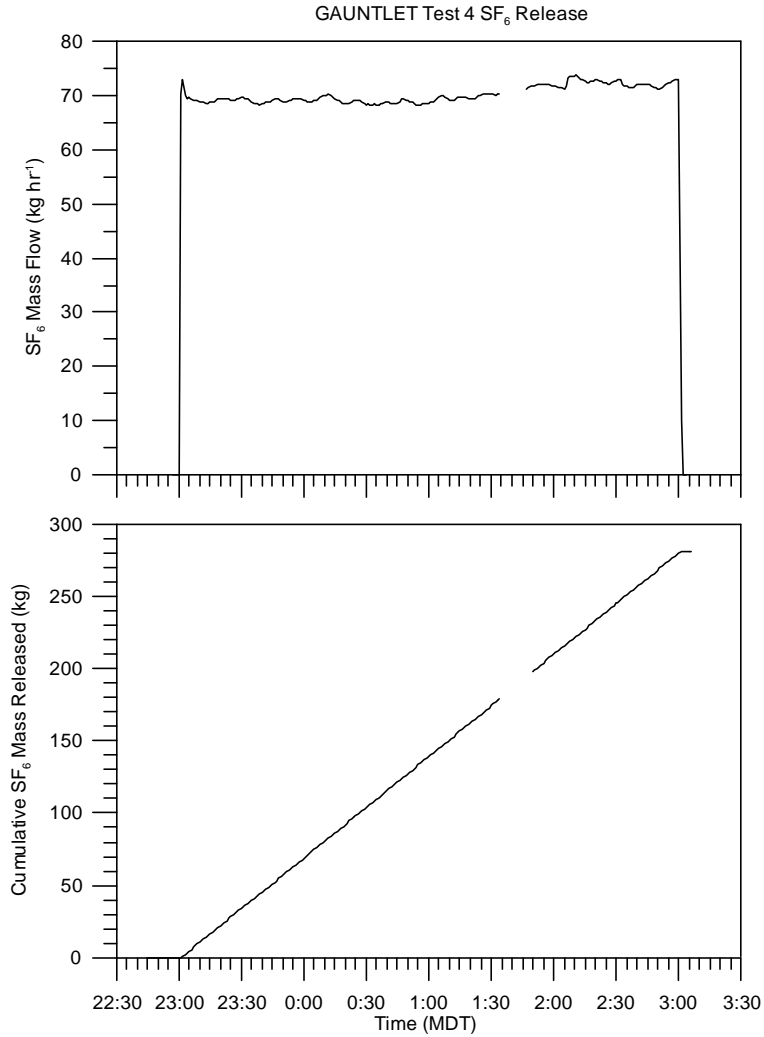


Figure 16. Test 4 SF₆ release rate from the mass flow meter (top) and cumulative mass of SF₆ released from the SF₆ cylinder load cells (bottom).

Table 7. Summary of Test 4 SF₆ sampling unit activity.

Sam-pling Unit	General Sampling Route	Total Number of Traverses	Number of Null Traverses	Number of Non-null Traverses	Maximum Concentration (pptv)	Bearing to Release Site (deg.)	Range to Release Site (km)
A	Tango Rd.	18	3	15	5028	311	16
B	TS-5 Rd.	11	5	6	366	324	51
C	I-80	14	4	10	96	345	77

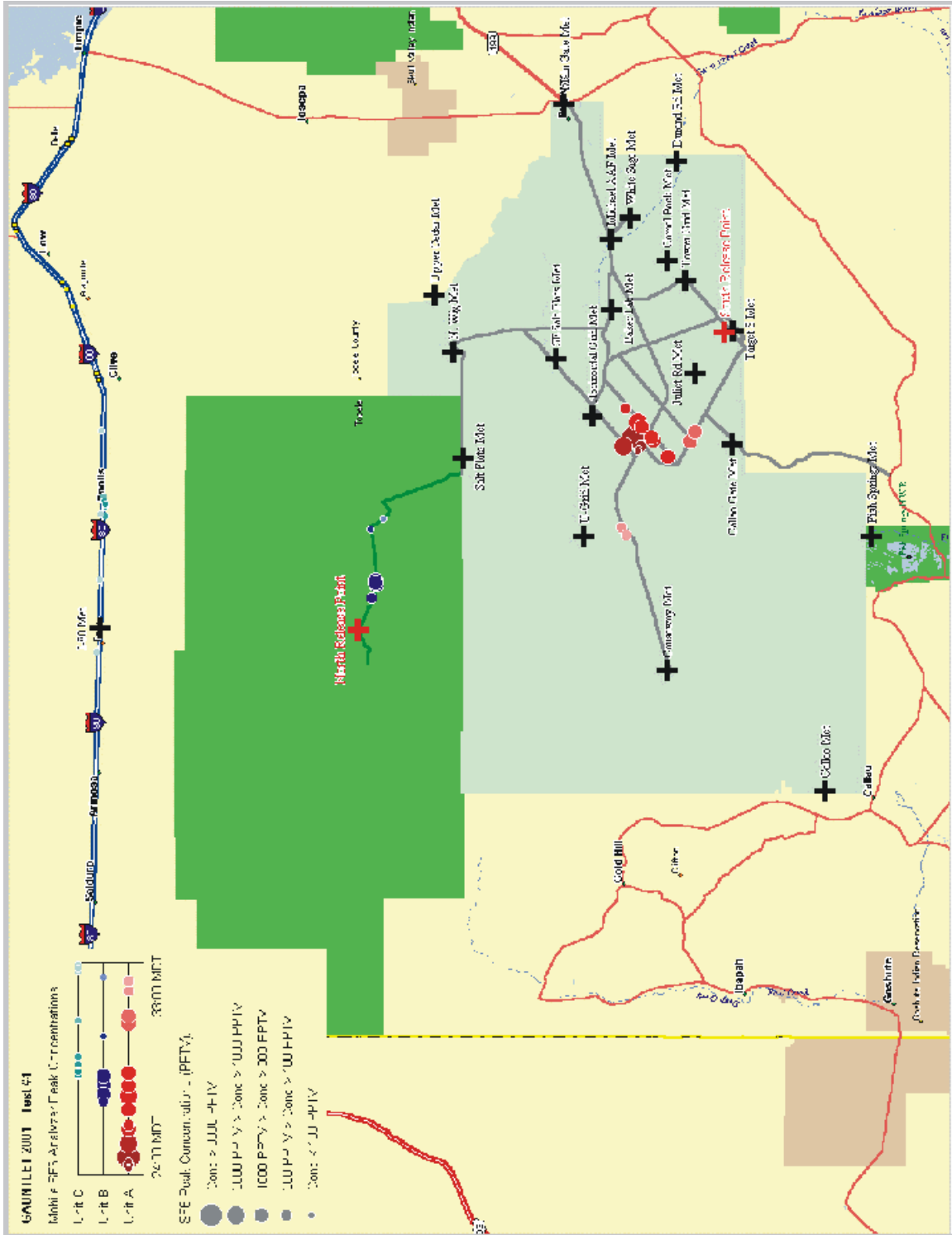


Figure 17. Test 4 maximum SF₆ concentration of each plume crossing for Sampling Unit A (red), Unit B (blue), and Unit C (teal) and time of measurement (upper left). Size of dot increases with increasing concentration. Dots on map indicate the geographical location of each maximum concentration. Color hue changes with increasing time.

Test 5 – 17-18 April 2001; SF₆ Release from 2200-0152 hours MDT

The release began at Target S (south release site) at 2200 hours at a target rate of 70 kg hr⁻¹. Winds were forecast to be out of the southeast. Sampling Units A, B, and C were deployed to X-Ray Road, TS-5 Road, and I-80, respectively. Skies at the time of the release were clear and winds were 3 m s⁻¹ from the southeast at Target S Grid.

Skies became overcast throughout the test with a thin layer of cirrus. The nocturnal inversion did not develop very strongly and the winds meandered some, but not as much as in Test 4. Winds increased in the morning hours, remaining southerly to southeasterly at 3-6 m s⁻¹.

At the start of the release, it became readily apparent that something was wrong with one or more of the tanks of SF₆. After some investigation, it was discovered that one unmarked tank had been fitted with a dip tube. This resulted in liquid SF₆ being drawn from the tank into the electronic metering and measuring portion of the release mechanism. The design of a liquid release mechanism is entirely different from that of a gaseous release mechanism. Liquid SF₆ in a gaseous release mechanism is dangerous, and can result in some of the components bursting as the liquid rapidly expands to the gas phase. The dip-tube tank was immediately shut-down, but only after o-ring seals in the release mechanism had been compromised. Removing the defective tank from the manifold would have cut the release time by 40 minutes. Fortunately, the FRD release technician was able to release minuscule amounts of liquid SF₆ from the defective tank while maintaining the integrity of the release system and also maintaining a constant release for nearly 4 hours. The release was terminated at 0152 hours MDT, only 8 minutes short of 4 hours, with a total release of 280.6 kg of SF₆ at an average rate of 70.2 kg hr⁻¹. Figure 18 shows the release rate and the cumulative amount of SF₆ released for the entire test. The mass flow trace indicates the presence of liquid SF₆ and is not to be construed as accurate because the flow meter was not designed to measure liquid SF₆. A constant release rate was maintained manually by the FRD technician.

The sampling units were active from 2200 through approximately 0700 hours MDT when the SF₆ plume was apparently no longer detectable. A total of 36 traverses were made during the test by the sampling units. Sampling unit activity is summarized in Table 8. A combined map/graph of the maximum plume concentration for each plume traverse and the location of those concentrations is shown in Figure 19. Sampling Unit A completed a total of 16 traverses, 14 of which yielded plume concentrations up to 853 pptv. Many of the plumes were centered near the Horizontal Grid Met Tower. Sampling Unit B completed a total of 6 traverses, 2 of which yielded plume concentrations up to 328 pptv. The plume had spread laterally so much that during one particular traverse, that it was found all along the road from Wig Mountain to the north release site at TS-5. Unit C completed a total of 14 traverses, 9 of which yielded plume concentrations up to 146 pptv. Most plumes were centered east of the Knolls exit on I-80. The bearings at which the maximum plume concentrations were measured were nearly identical for Sampling Units A and B but for Sampling Unit C the location was almost due north of the release site. The low concentration observations indicate that much of the material might have been trapped aloft instead of being trapped in the near-surface layer as was the case in Test 3.

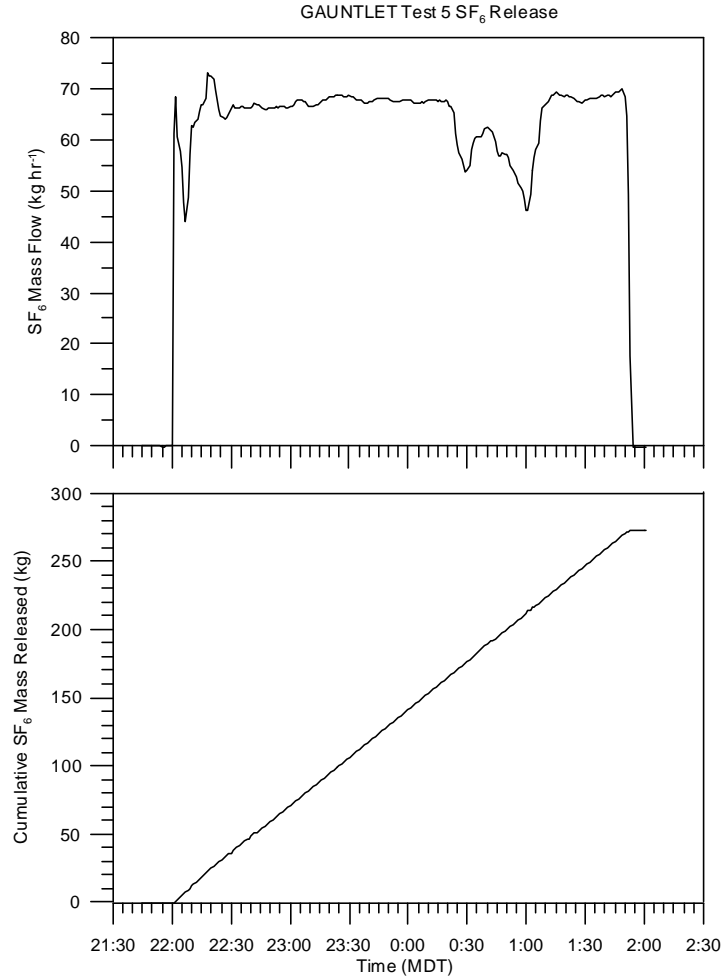


Figure 18. Test 5 SF₆ release rate from the mass flow meter (top) and cumulative mass of SF₆ released from the SF₆ cylinder load cells (bottom). Mass flow meter readings are inaccurate due to the presence of liquid SF₆ in the system.

Table 8. Summary of Test 5 SF₆ sampling unit activity.

Sam-pling Unit	General Sampling Route	Total Number of Traverses	Number of Null Traverses	Number of Non-null Traverses	Maximum Concentration (pptv)	Bearing to Release Site (deg.)	Range to Release Site (km)
A	X-Ray Rd.	16	2	14	853	321	17
B	TS-5 Rd.	6	4	2	304	328	36
C	I-80	14	5	9	146	351	75

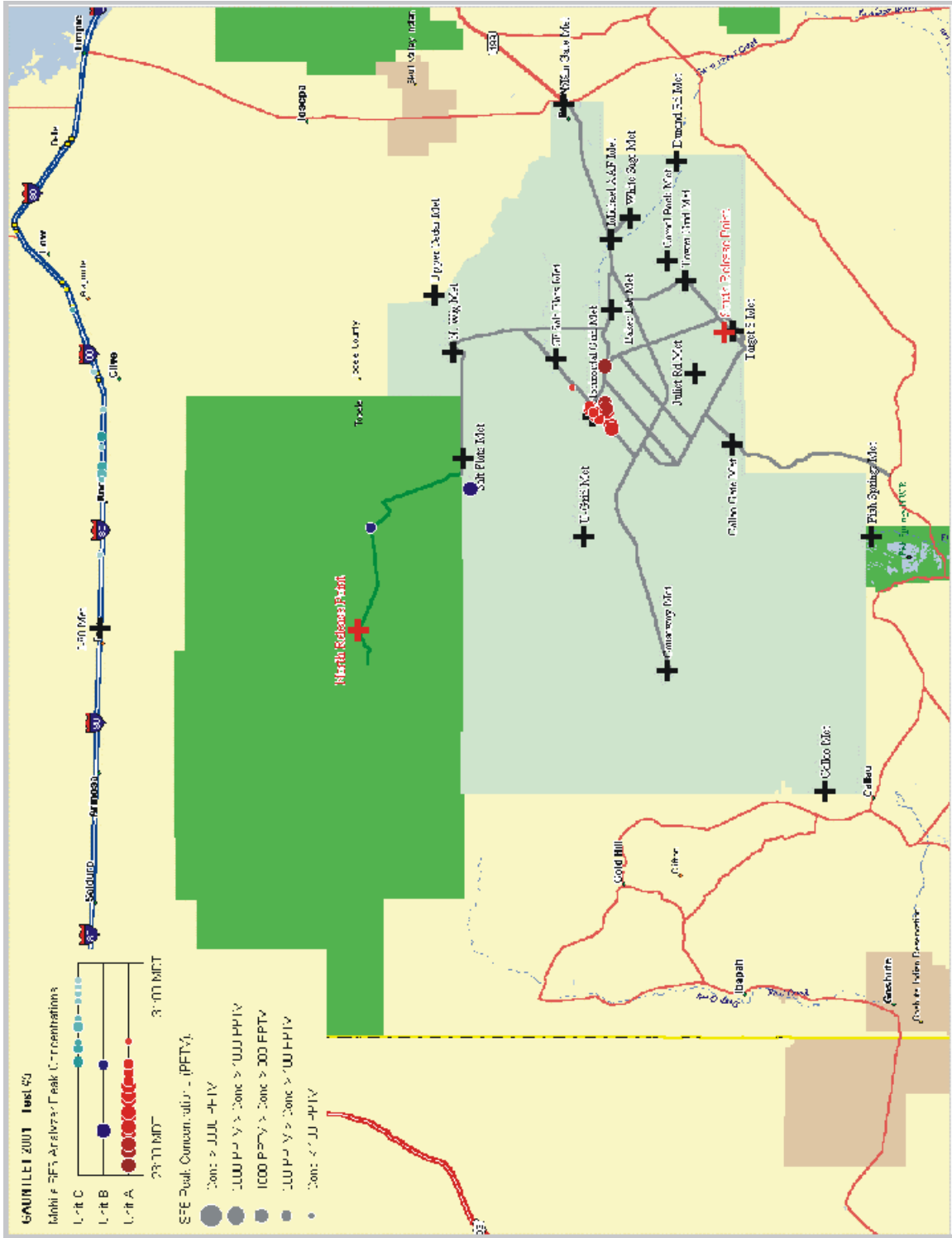


Figure 19. Test 5 maximum SF₆ concentration of each plume crossing for Sampling Unit A (red), Unit B (blue), and Unit C (teal) and time of measurement (upper left). Size of dot increases with increasing concentration. Dots on map indicate the geographical location of each maximum concentration. Color hue changes with increasing time.

Test 6 – 24 April 2001; SF₆ Release from 0100-0500 hours MDT

The release began at Target S (south release site) at 0100 hours after a delay of 1 hour past the scheduled start time. The target release rate was 70 kg hr⁻¹. Winds were forecast to be light and out of the east-southeast. Therefore, Sampling Unit C was not deployed for this test because the forecast trajectory would not bring the material to I-80. Sampling Unit A was deployed to Tango Road and Unit B was deployed to X-Ray Road.

Skies at the time of the release were clear and winds were 1-2 m s⁻¹ from the southeast at Target S Grid. Skies remained clear throughout the test. Winds were light and variable, but the material was still transported as far north as X-Ray Road. Winds at I-80 were out of the north, which verified the forecast of no material transport to I-80.

The release was terminated as scheduled at 0500 hours MDT, resulting in a 4-hour release. A total of 281.0 kg of SF₆ was released at an average rate of 70.3 kg hr⁻¹. No problems were encountered during this release. Figure 20 shows the release rate and the cumulative amount of SF₆ released for the entire test.

The sampling units were active from 0100 through approximately 0830 hours MDT when measurements indicated that most of the plume had advected out of the sampling area. Sampling unit activity is summarized in Table 9. A total of 26 traverses were made during the test by the sampling units. A combined map/graph of the maximum plume concentration for each plume traverse and the location of those concentrations is shown in Figure 21. Sampling Unit A completed a total of 15 traverses, 13 of which yielded plume concentrations up to 3461 pptv. The plumes were measured all along Tango Road. The edge of the SF₆ plume moved westerly, forcing Sampling Unit A to move south along West Downwind Road in a somewhat parallel position with the plume to emerge from the plume for signal baseline determination. Sampling Unit B completed a total of 11 traverses, 9 of which yielded plume concentrations up to 4265 pptv. Maximum SF₆ concentration in Plume 3 from Unit B was more than 10 % above the maximum concentration of the calibration gases, making that value more uncertain. A lower maximum calibration gas concentration of 2915 pptv was used because the 5100 pptv calibration gas over-ranged the instrument this particular test day and had to be discarded. Plumes were measured by this unit from just west of the Horizontal Grid Met Tower to a point at the north end of Granite Mountain. Unit C was not used during the study. The bearings at which the maximum plume concentrations were measured were nearly identical for Sampling Units A and B and the range to the release site was only 3 km greater for Unit B. This explains the similarity of maximum concentrations determined from each sampling unit. A nocturnal inversion did again set up for this test, which was stronger than that of Tests 4 and 5, but was not as strong as Test 3 when maximum concentrations well above 4,000 pptv were observed.

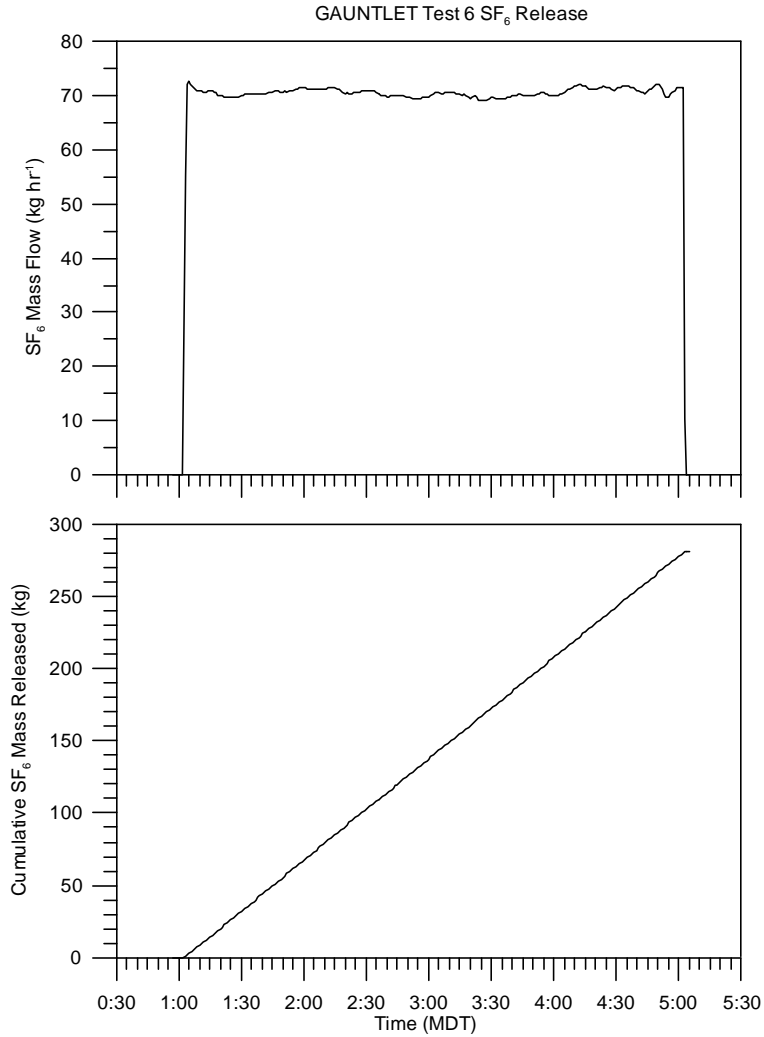


Figure 20. Test 6 SF₆ release rate from the mass flow meter (top) and cumulative mass of SF₆ released from the SF₆ cylinder load cells (bottom).

Table 9. Summary of Test 6 SF₆ sampling unit activity.

Sam-pling Unit	General Sampling Route	Total Number of Traverses	Number of Null Traverses	Number of Non-null Traverses	Maximum Concentration (pptv)	Bearing to Release Site (deg.)	Range to Release Site (km)
A	Tango Rd.	15	2	13	3461	314	15
B	X-Ray Rd.	11	2	9	4265	318	18
C	Not Used	----	----	----	----	----	----

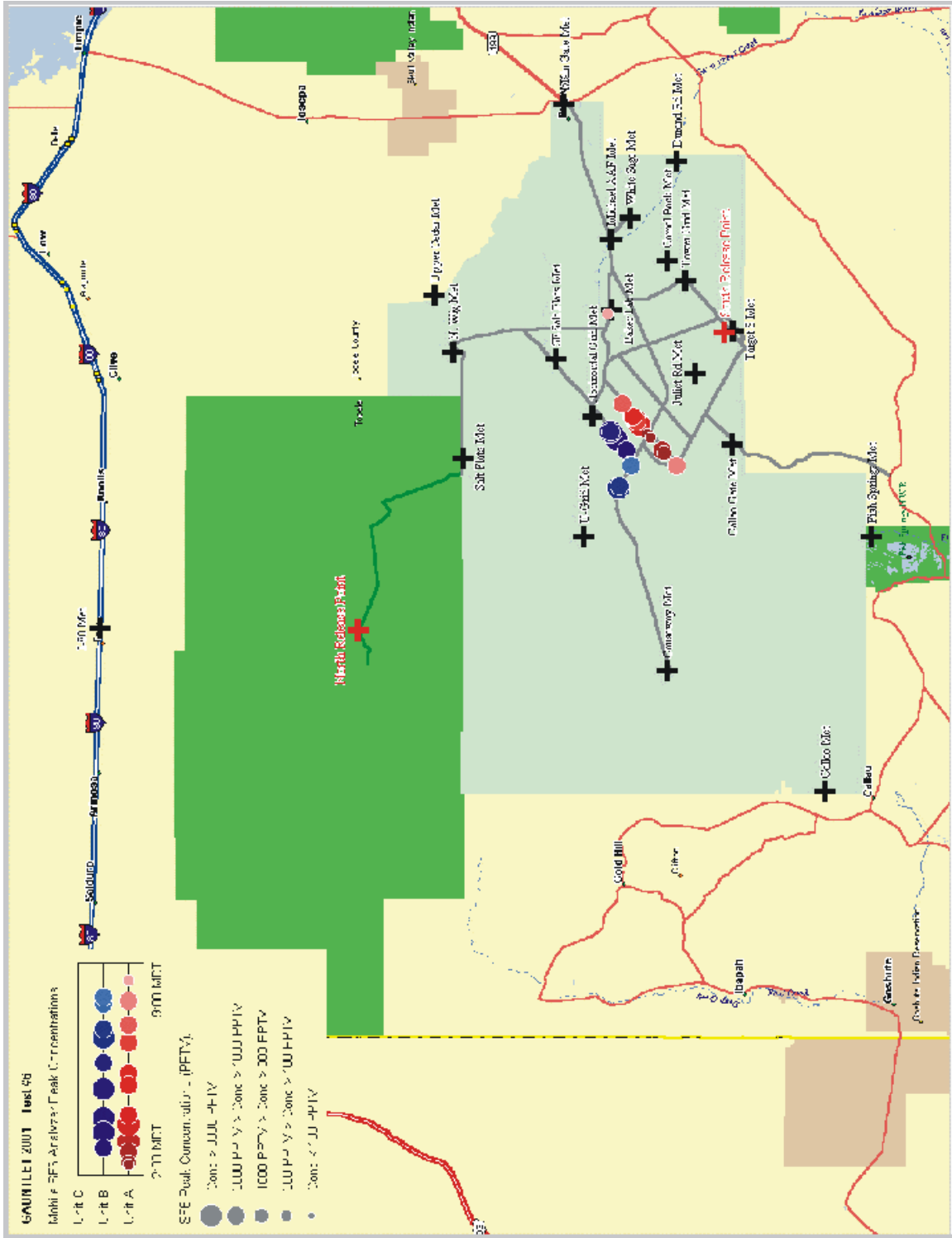


Figure 21. Test 6 maximum SF₆ concentration of each plume crossing for Sampling Unit A (red) and Unit B (blue), and time of measurement (upper left). Size of dot increases with increasing concentration. Dots on map indicate the geographical location of each maximum concentration. Color hue changes with increasing time.

Test 7 (postponed) – 25 April 2001; Release postponed

Winds were forecast to be from the southeast for a intended 0200 hour MDT release. However, winds remained light and variable during the window of opportunity and the release was postponed.

Test 7 – 26 April 2001; SF₆ Release from 0200-0600 hours MDT

The release was scheduled to begin at 0000 hours MDT at the south release point (Target S Grid). Light southeasterly winds were forecast to occur during the test. The winds did not set up in the appropriate direction at Target S until 0200 hours when the SF₆ release began at the planned rate of 70 kg hr⁻¹. Skies were clear and winds were approximately 2 m s⁻¹ from the southeast. Sampling Units A and B were deployed to X-Ray Road and Sand Island-TS-5 Roads, respectively. Sampling Unit C was again not deployed because the trajectory forecast indicated that the material would not be transported to I-80.

Skies remained clear throughout the test. The winds occasionally became light and variable, but generally persisted from the east and east-southeast at 1-3 m s⁻¹ until about 0900 hours MDT. At that time, winds became light and variable and transport of the SF₆ appeared to cease.

The release was terminated as scheduled at 0600 hours MDT, resulting in a 4-hour release. A total of 280.5 kg of SF₆ was released at an average rate of 70.1 kg hr⁻¹. Figure 22 shows the release rate and the cumulative amount of SF₆ released for the entire test. Again, no technical problems were encountered during this release.

The sampling units were active from 0200 through approximately 1100 hours MDT when the decision was made to terminate measurements, even though the SF₆ plume was still detectable. Sampling unit activity is summarized in Table 10. A total of 26 traverses were made during the test by the sampling units. A combined map/graph of the maximum plume concentration for each plume traverse and the location of those concentrations is shown in Figure 23. Sampling Unit A encountered high concentrations on Plumes 9 and 10 that over-ranged the analyzer. This resulted in flat-top peaks. Subsequently Unit A used a dilution system on Plumes 11 and 12. This allowed the analyzer to measure concentrations up to 10,200 pptv (twice the concentration of the highest calibration gas) without extrapolating beyond the calibration curve. Sampling Unit A completed a total of 18 traverses and measured SF₆ on 13 traverses, with a maximum concentration of 9,011 pptv at a distance of 18 km from the release site. This unit observed plumes from the Horizontal Grid Met Tower west to a point north of Granite Mountain. Sampling Unit B completed a total of 8 traverses and sampled the plume on 5 of those traverses. Unit B measured a maximum concentration of 2168 pptv 38 km from the release site. During the course of the test, Unit B eventually measured SF₆ from Wig Mountain all along the full extent of the road to TS-5. Unit C was not deployed. The maximum concentration of one plume traverse made during this test exceeded those of Test 3 primarily because of the low wind speed observed during this test. The material did not dilute as rapidly as was observed in nocturnal Tests 4-6.

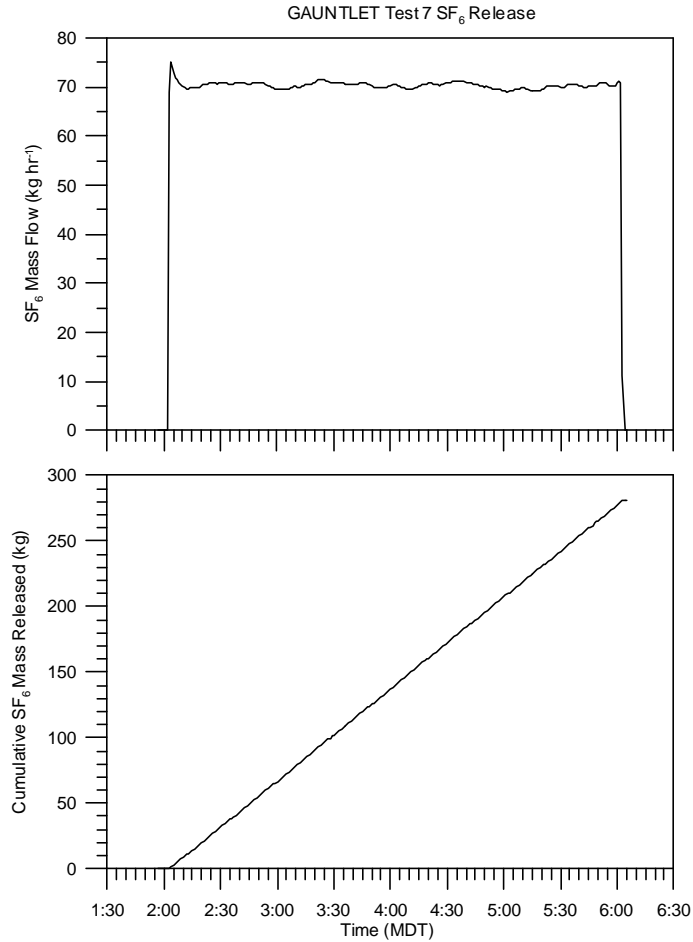


Figure 22. Test 7 SF₆ release rate from the mass flow meter (top) and the cumulative mass of SF₆ released from the SF₆ cylinder load cells (bottom).

Table 10. Summary of Test 7 SF₆ sampling unit activity.

Sam- pling Unit	General Sampling Route	Total Number of Traverses	Number of Null Traverses	Number of Non-null Traverses	Maximum Concentration (pptv)	Bearing to Release Site (deg.)	Range to Release Site (km)
A	X-Ray Rd.	18	5	13	9011	334	18
B	TS-5 & Wig Mtn. Rds.	8	3	5	2168	332	38
C	Not Used	----	----	----	----	----	----

SUMMARY AND CONCLUSIONS

Seven SF₆ tracer tests were conducted at Dugway Proving Ground by NOAA Air Resources Laboratory Field Research Division. A mix of daytime and nocturnal tests were conducted. The tests consisted of both releasing and measuring the SF₆ with real-time mobile analyzers. SF₆ was continuously released for four hours during each test at a nominal rate of 70 kg hr⁻¹. Daytime conditions caused the SF₆ to dilute such that in most cases, the material was below detection limits at distances greater than 50 km. However, at night the material was detected at distances approaching 80 km. Local topography influenced the trajectory of the material, as did the strength of the inversion. The data provided herein can be used to verify many different types of transport and dispersion models.

ACKNOWLEDGMENTS

Shane Beard constructed and operated the SF₆ mobile release mechanism. Eric Egan also assisted with the construction of the release mechanism. Eric Egan, David George, Dianne Hoover, and Mark Hoover assisted with the operation of the real-time mobile SF₆ analyzers. We thank our hosts at the Dugway Proving Ground, among them Jimmy White and Brent Fields, for their kind assistance. This project was funded by the Air Force Technical Applications Center (AFTAC) under AFTAC Acquisition Requirement Number T/1401.

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- Watson, T. B., R. E. Keislar, B. Reese, R. G. Carter, S. Turley, B. Grim, and C. A. Biltoft. 1998. The Defense Special Weapons Agency Dipole Pride 26 field experiment. NOAA Tech. Memo. ERL ARL-225.

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Appendix A

Individual SF₆ Plume Traverses

**Background Test 1
Sampling Unit A**

Sampling Unit A did not encounter any SF₆ during Background Test 1.

**Background Test 1
Sampling Unit B**

Sampling Unit B did not encounter any SF₆ during Background Test 1.

**Background Test 1
Sampling Unit C**

Sampling Unit C did not encounter any SF₆ during Background Test 1.

Background Test 2 Sampling Unit A

Table A-1. Summary of individual SF₆ plume characteristics measured by Sampling Unit A during Background Test 2. Bearings and ranges are calculated to the South Release Point (Target S Grid).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Minimum (km)	Average (km)	Maximum (km)
1	14:15-14:17	281	305.1-305.9	16.73	17.45	18.44

Table A-2. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit A during Background Test 2.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	26.4	14:16	40.147740	113.211887	305.8	16.91

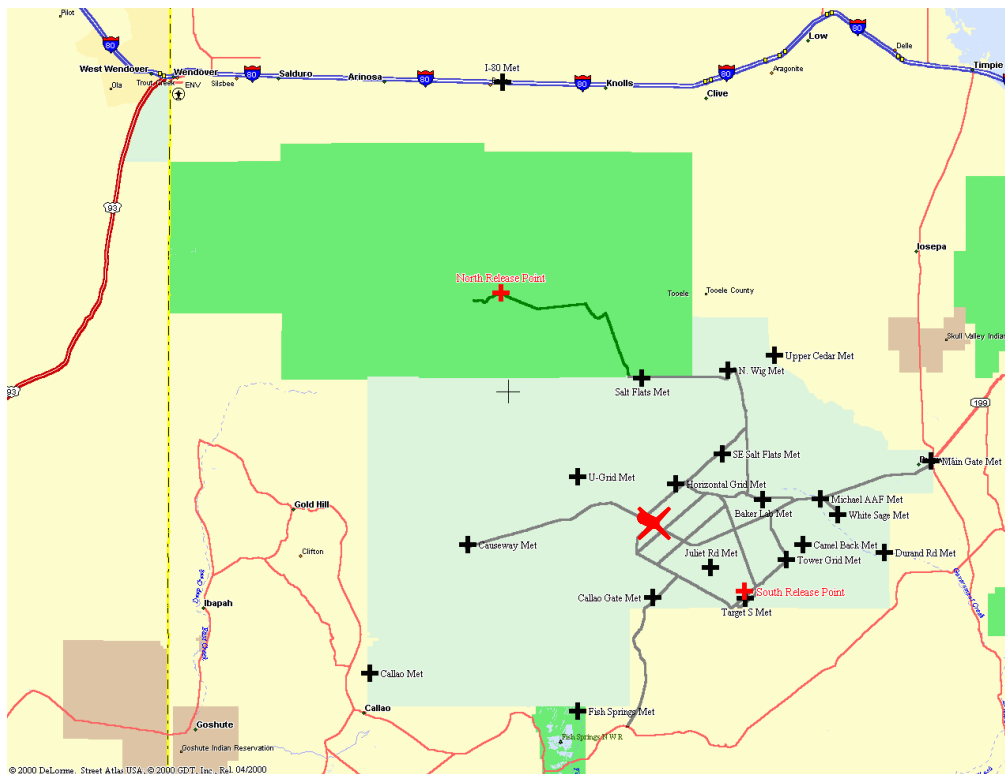
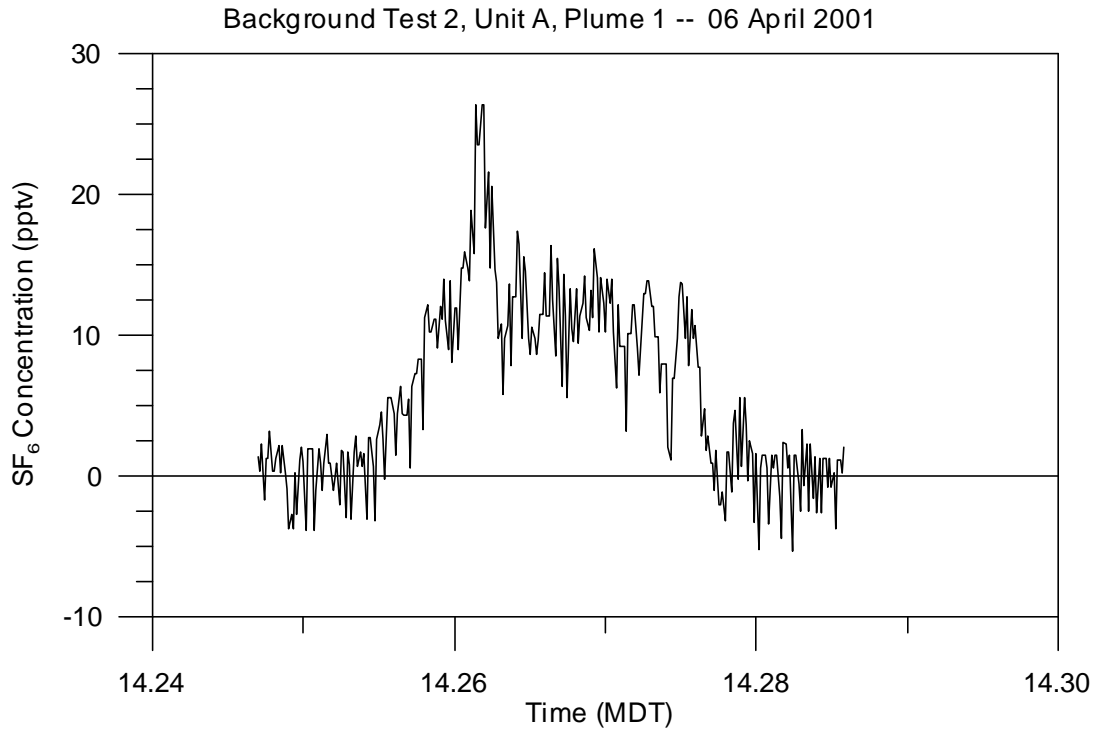


Figure A-1. SF₆ concentration of Plume 1 for Sampling Unit A during Background Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Background Test 2 Sampling Unit B

Table A-3. Summary of individual SF₆ plume characteristics measured by Sampling Unit B during Background Test 2. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	13:22-13:30	989	60.2-187.8	0.14	0.27	0.78
2	13:42-13:45	285	186.5-186.7	0.25	0.25	0.25
3	13:45-13:47	230	183.0-186.7	0.25	0.26	0.27

Table A-4. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit B during Background Test 2.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	1576.8	13:26	40.056363	113.051548	187.8	0.25
2	546.2	13:43	40.056375	113.051482	186.6	0.25
3	762.8	13:45	40.056382	113.051485	186.6	0.25

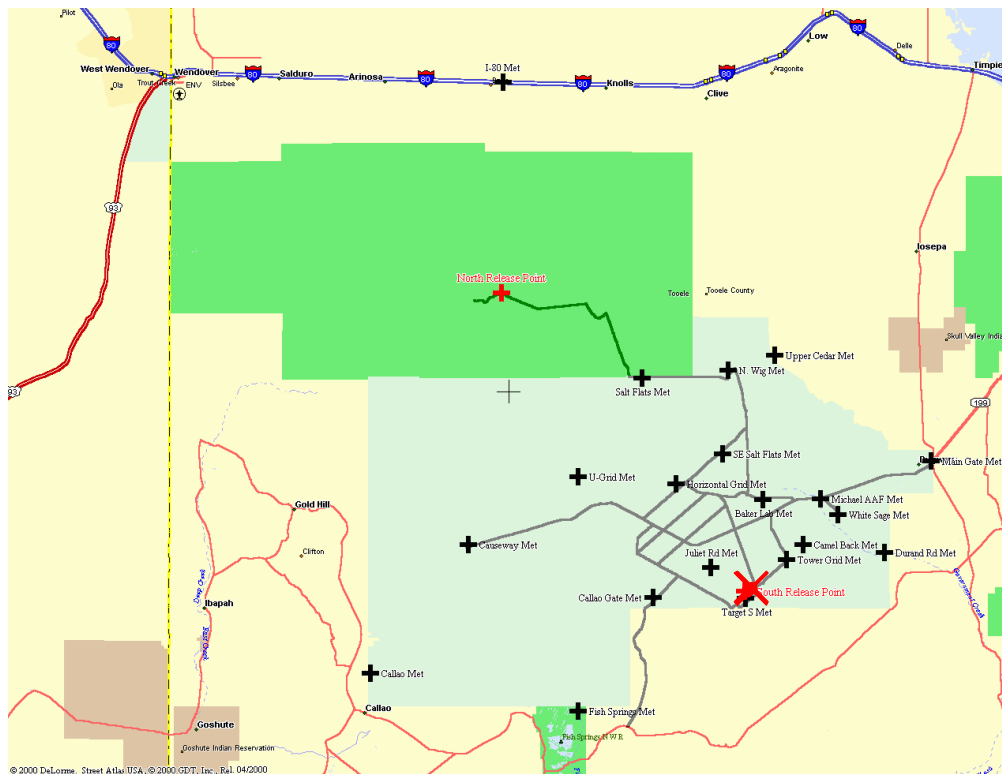
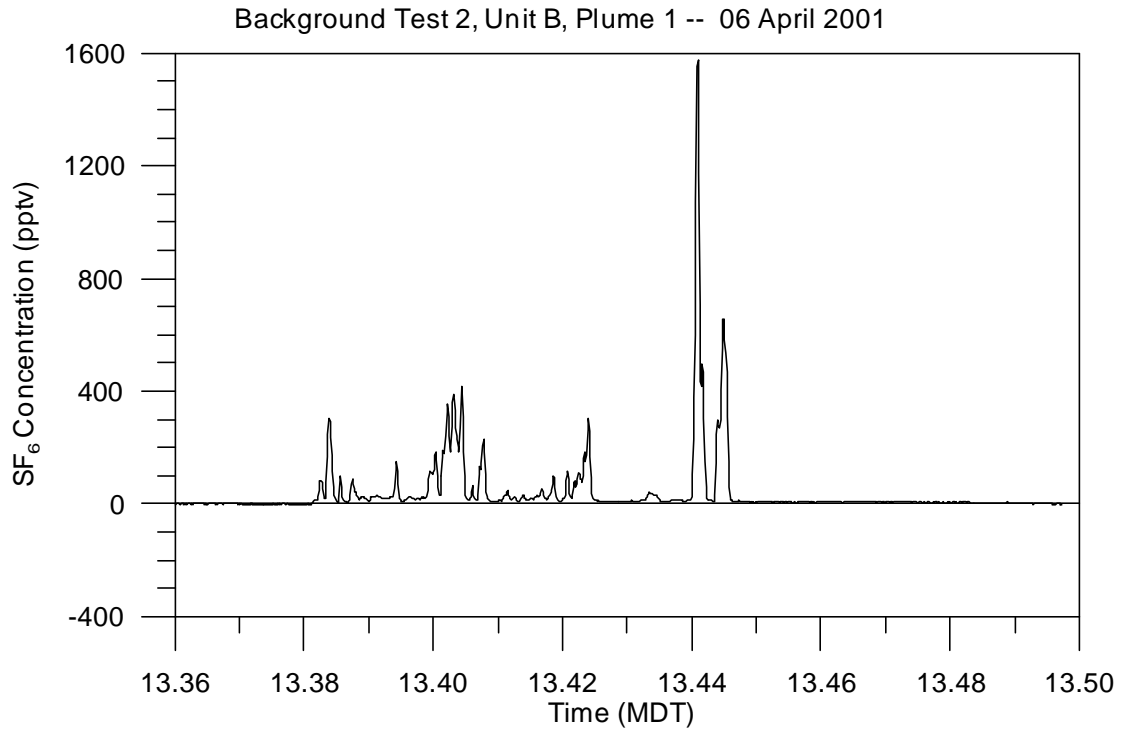


Figure A-2. SF₆ concentration of Plume 1 for Sampling Unit B during Background Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

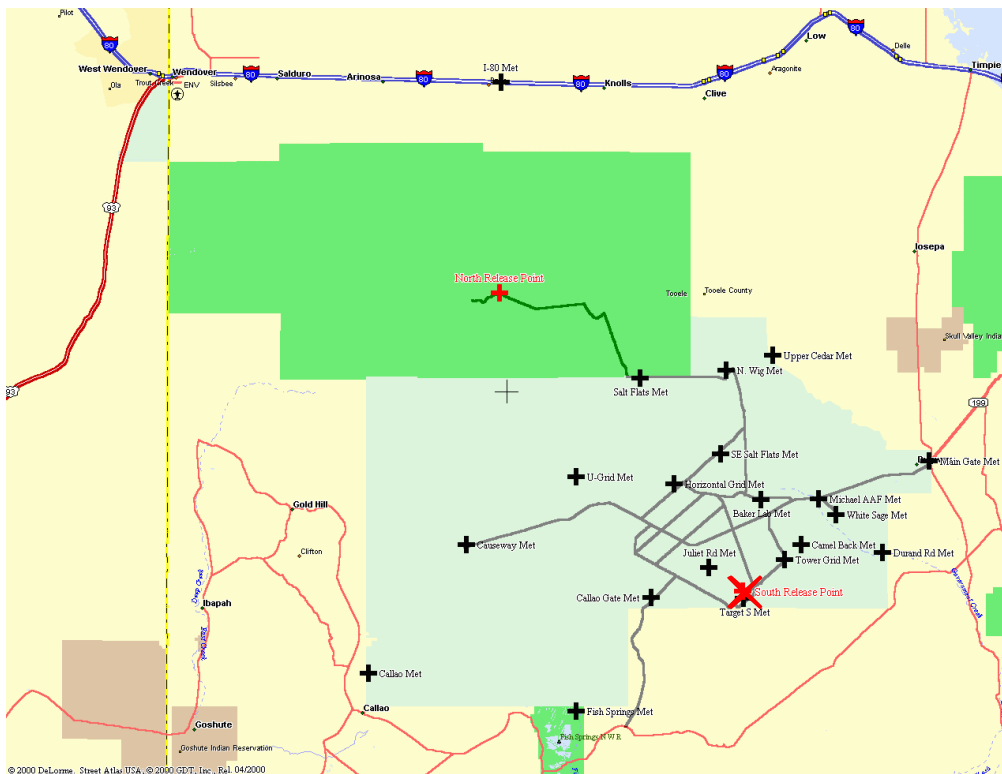
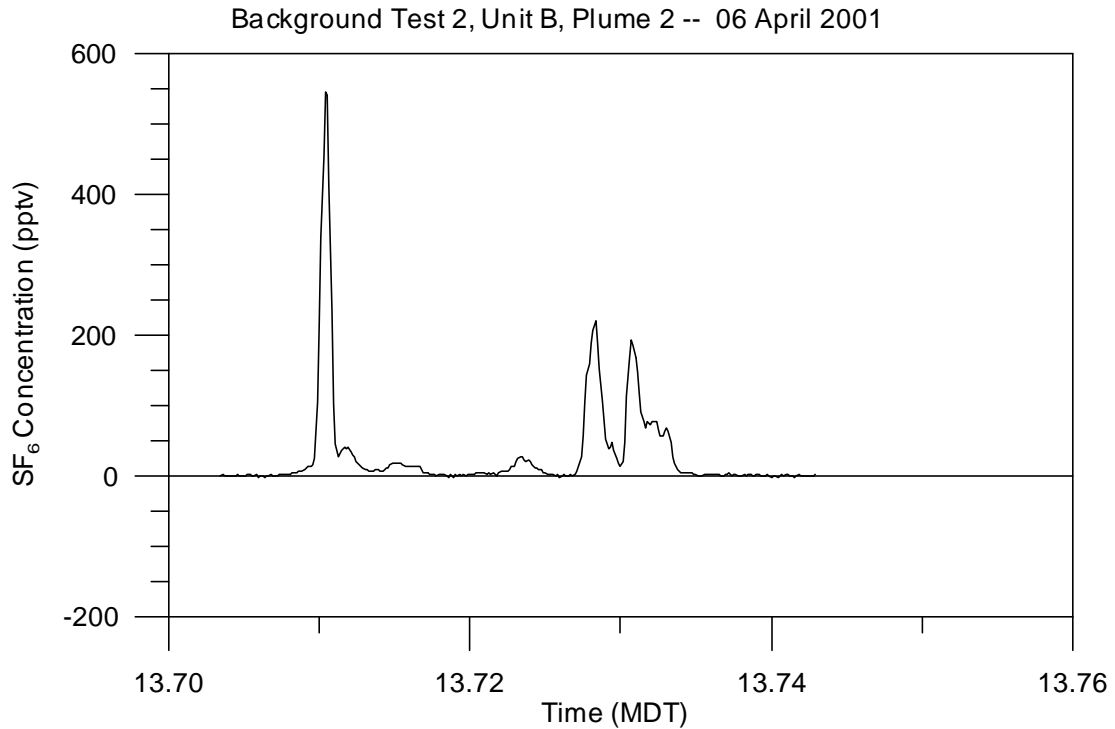


Figure A-3. SF₆ concentration of Plume 2 for Sampling Unit B during Background Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

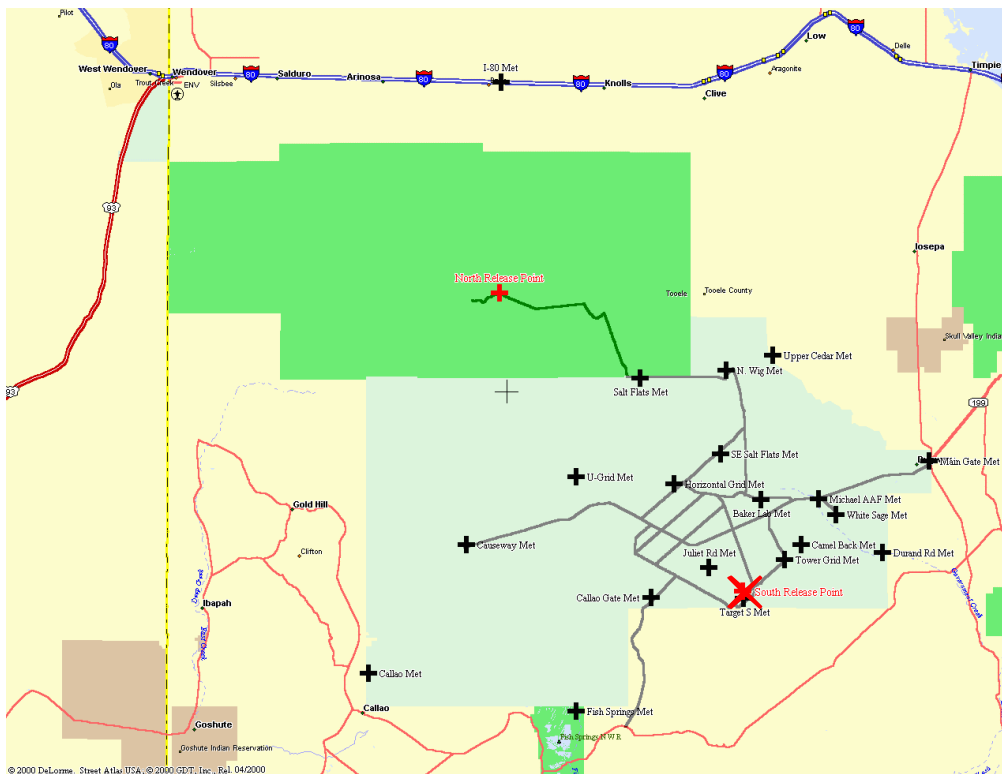
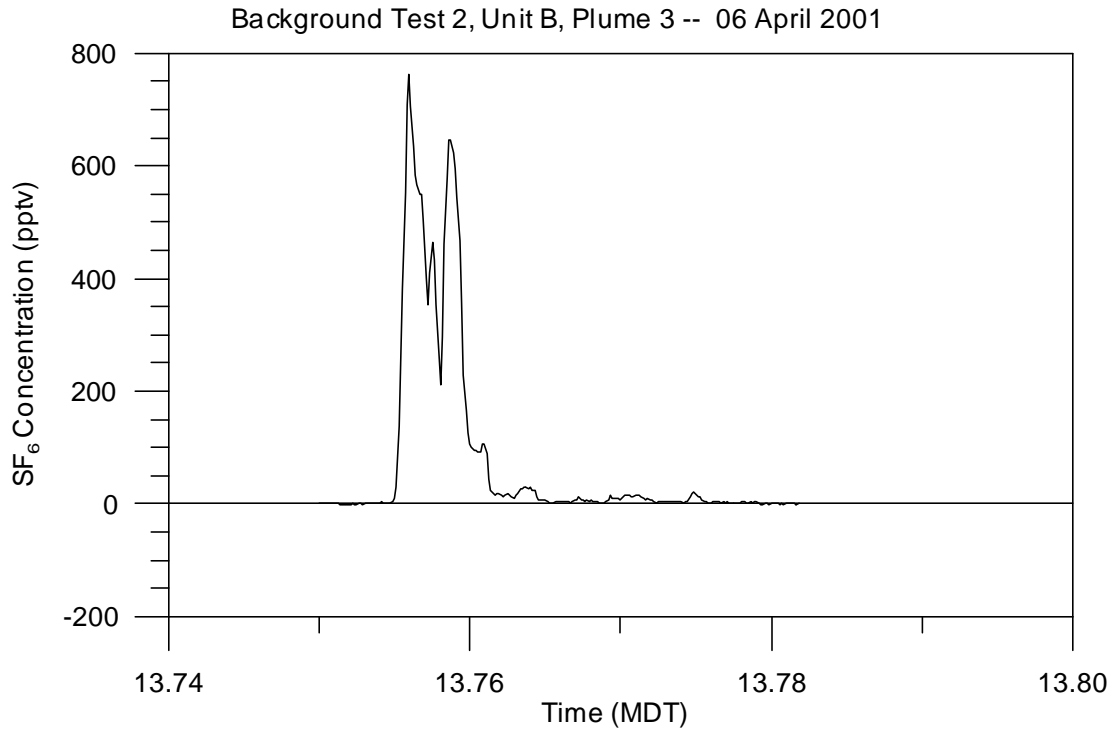


Figure A-4. SF₆ concentration of Plume 3 for Sampling Unit B during Background Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Background Test 2 Sampling Unit C

Sampling Unit C did not encounter any SF₆ during Background Test 2.

Test 1 Sampling Unit A

Table A-5. Test 1 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	12:26	12:47

Table A-6. Summary of individual SF₆ plume characteristics measured by Sampling Unit A during Test 1. Bearings and ranges are given to the North Release Point (TS-5).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	12:55-13:02	861	165.1-176.7	34.40	34.73	35.27
2	13:15-13:25	1228	163.0-176.9	34.41	34.68	35.30
3	13:37-13:41	537	165.8-174.6	34.41	34.64	35.00
4	13:48-14:00	1460	162.6-179.1	34.40	34.73	35.65
5	14:05-14:13	925	161.2-174.9	34.41	34.62	35.05
6	14:52-15:03	1392	162.3-179.1	34.41	34.86	35.65
7	15:05-15:14	1059	161.5-179.0	34.41	34.86	35.64
8	15:27-15:43	1922	156.3-180.1	33.86	34.74	35.82
9	15:54-16:00	767	164.4-176.4	34.41	34.71	35.23
10	16:15-16:34	2315	158.6-185.7	34.03	35.08	37.07
11	16:45-16:55	1273	158.4-175.6	34.01	34.54	35.13
12	17:05-17:12	861	151.3-157.3	33.85	34.74	35.51

Table A-7. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the North Release Point (TS-5) of each individual plume traverse measured by Sampling Unit A during Test 1.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	58.5	13:00	40.147977	113.391793	168.5	34.50
2	46.4	13:19	40.151365	113.376415	166.3	34.42
3	76.2	13:38	40.142180	113.418088	172.4	34.77
4	60.2	13:55	40.146620	113.397748	169.4	34.56
5	57.8	14:09	40.148577	113.388970	168.1	34.49
6	90.3	14:56	40.148350	113.390002	168.3	34.49
7	34.0	15:09	40.142687	113.415398	172.0	34.74
8	40.8	15:35	40.146065	113.400292	169.8	34.58
9	28.1	15:59	40.149188	113.386217	167.7	34.47
10	34.3	16:22	40.150728	113.379253	166.7	34.43
11	46.1	16:51	40.153937	113.351670	162.8	34.71
12	19.1	17:07	40.173852	113.274703	151.5	35.20

No null passes were made by Sampling Unit A either during or after the time period of active plume sampling listed in the previous two tables.

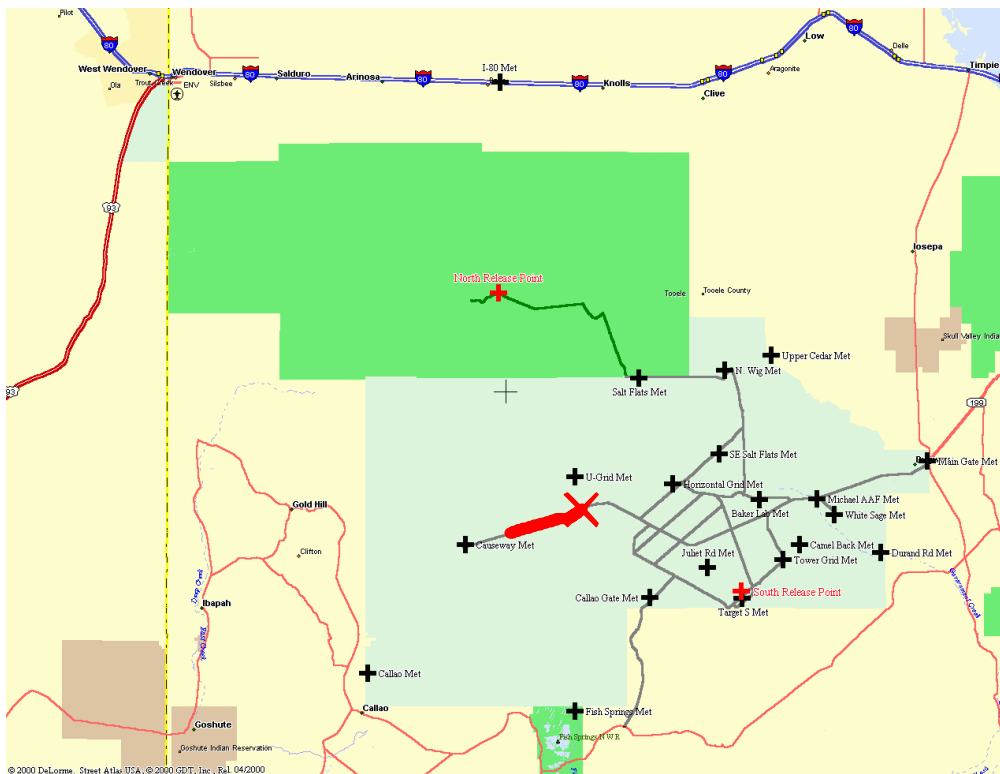
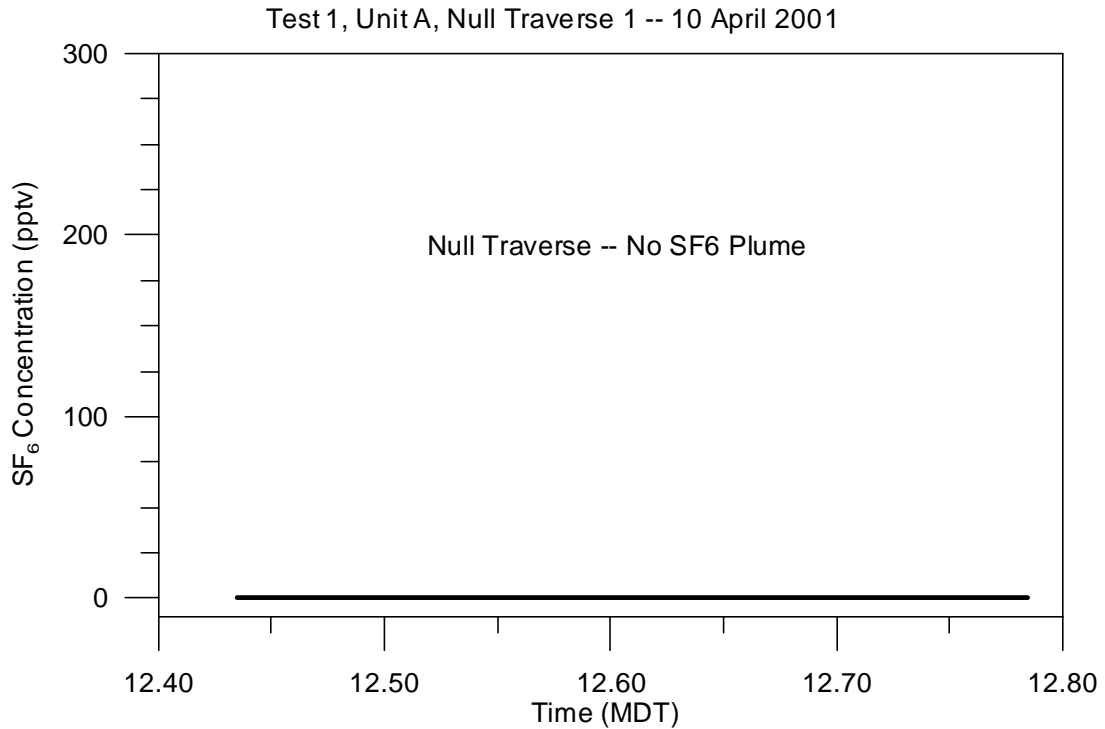


Figure A-5. Null sampling traverse 1 made by Sampling Unit A during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

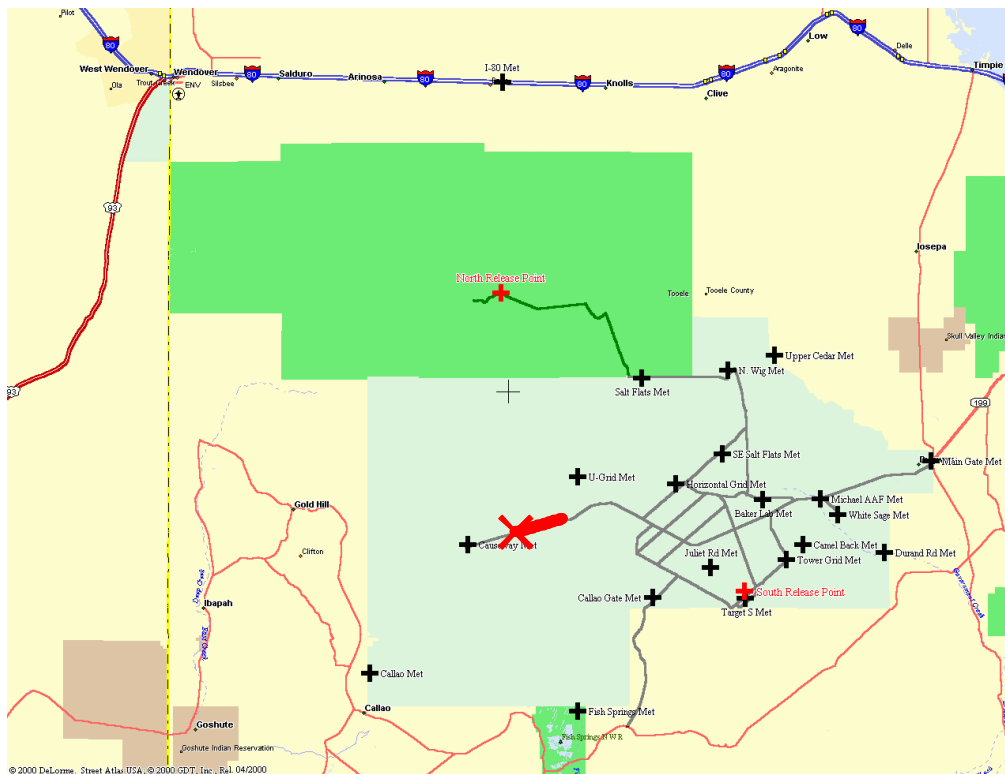
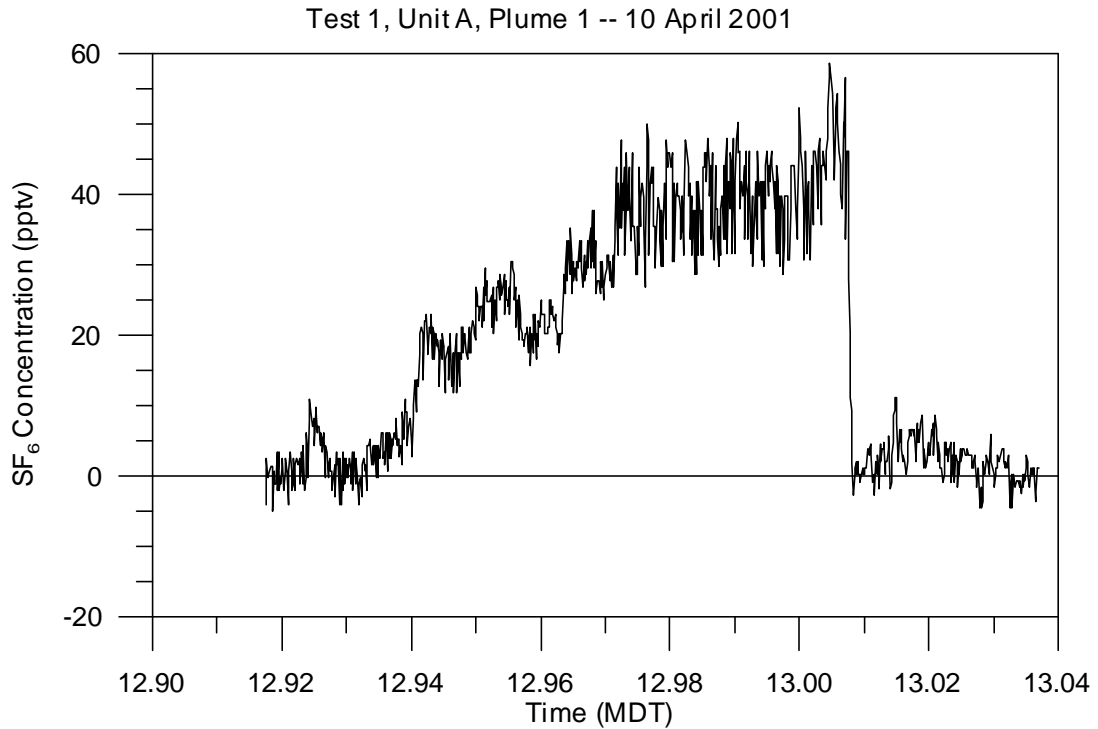


Figure A-6. SF₆ concentration of Plume 1 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

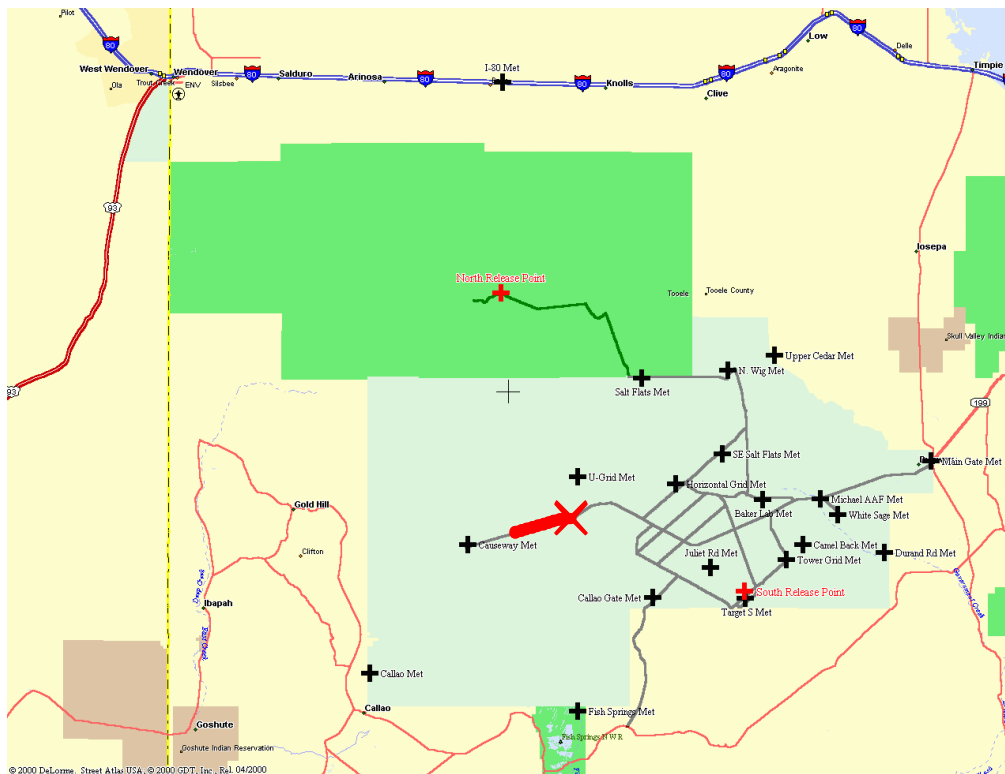
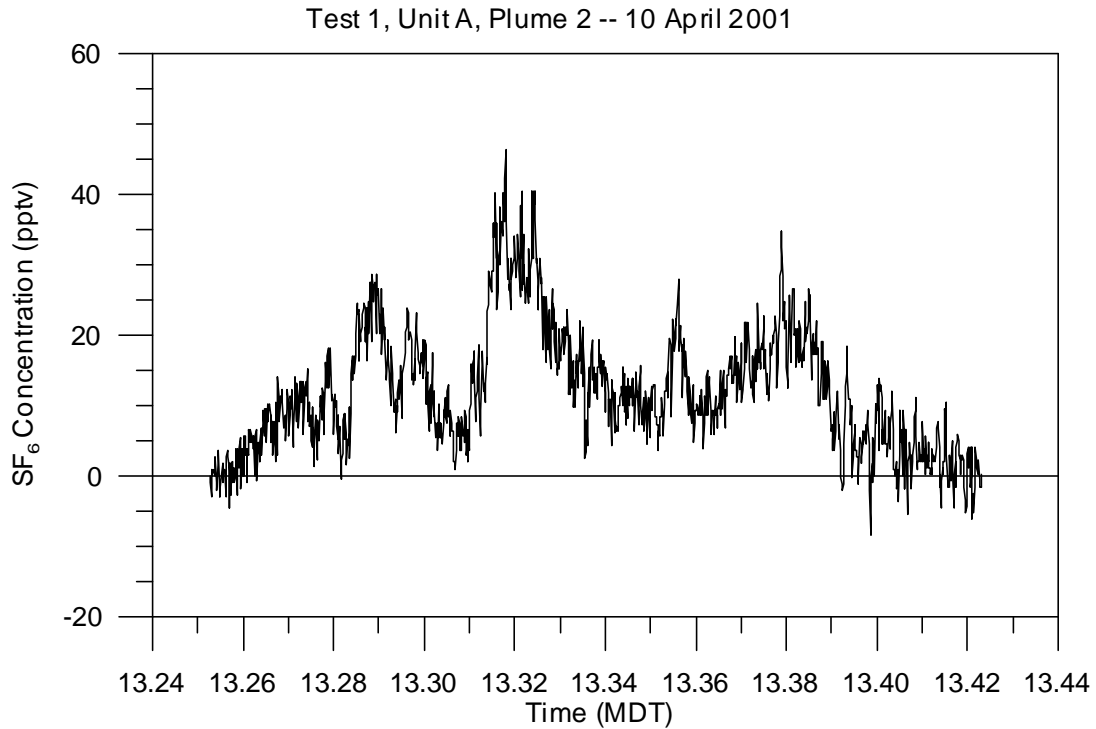


Figure A-7. SF₆ concentration of Plume 2 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

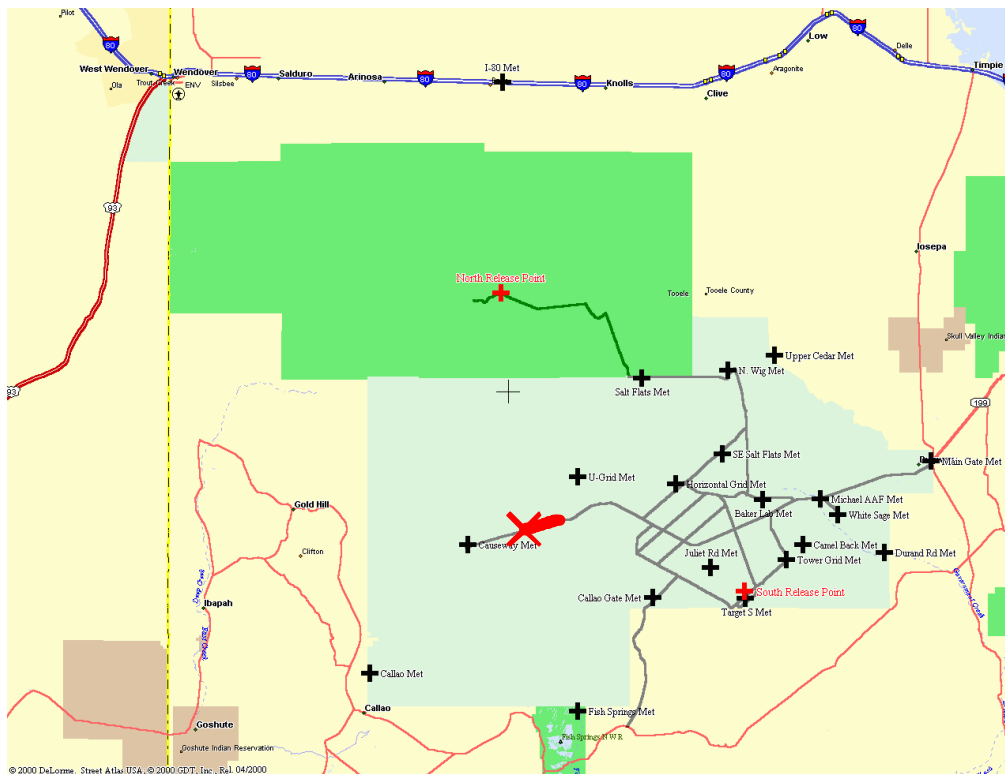
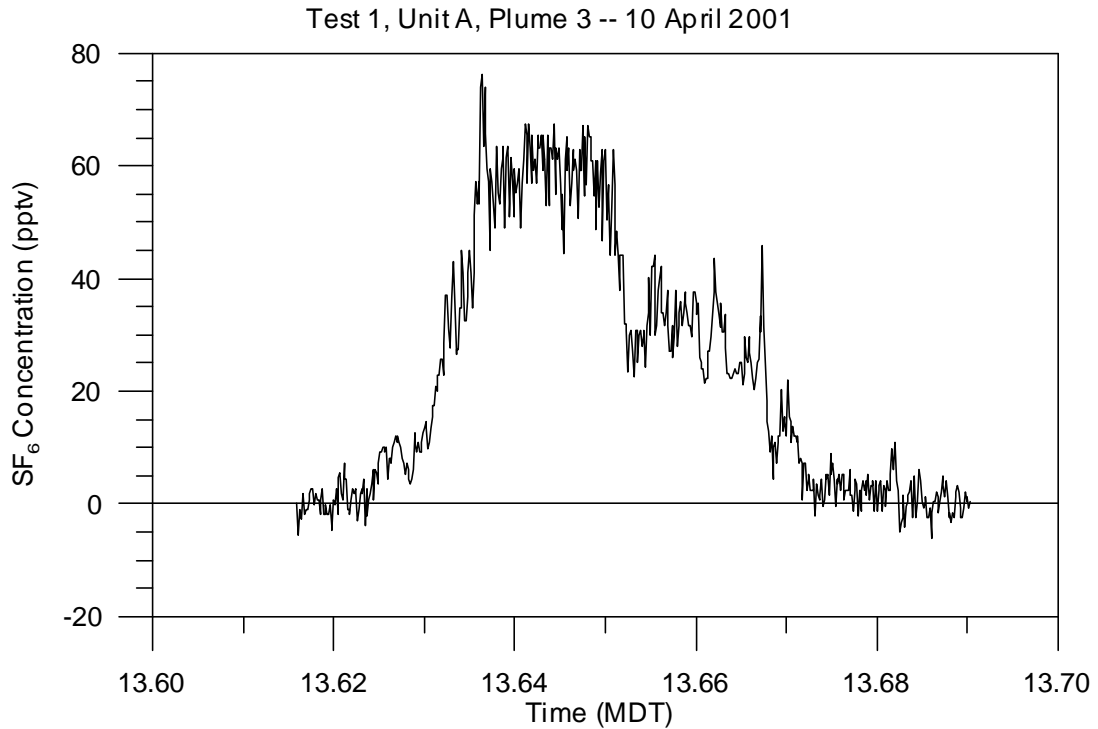


Figure A-8. SF₆ concentration of Plume 3 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

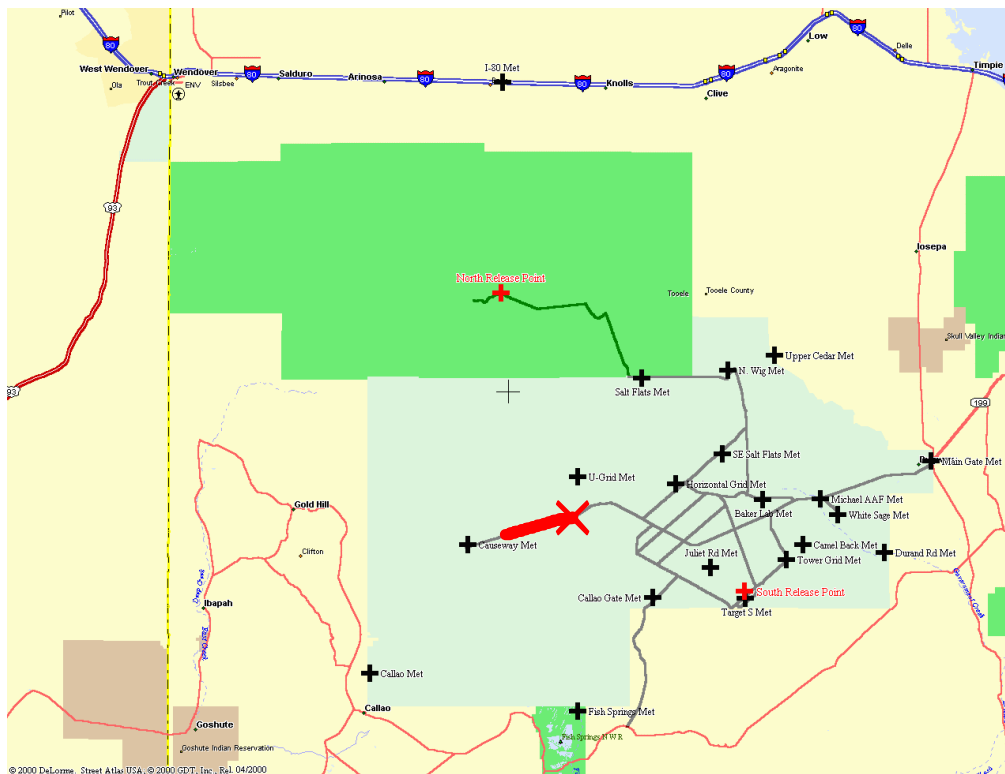
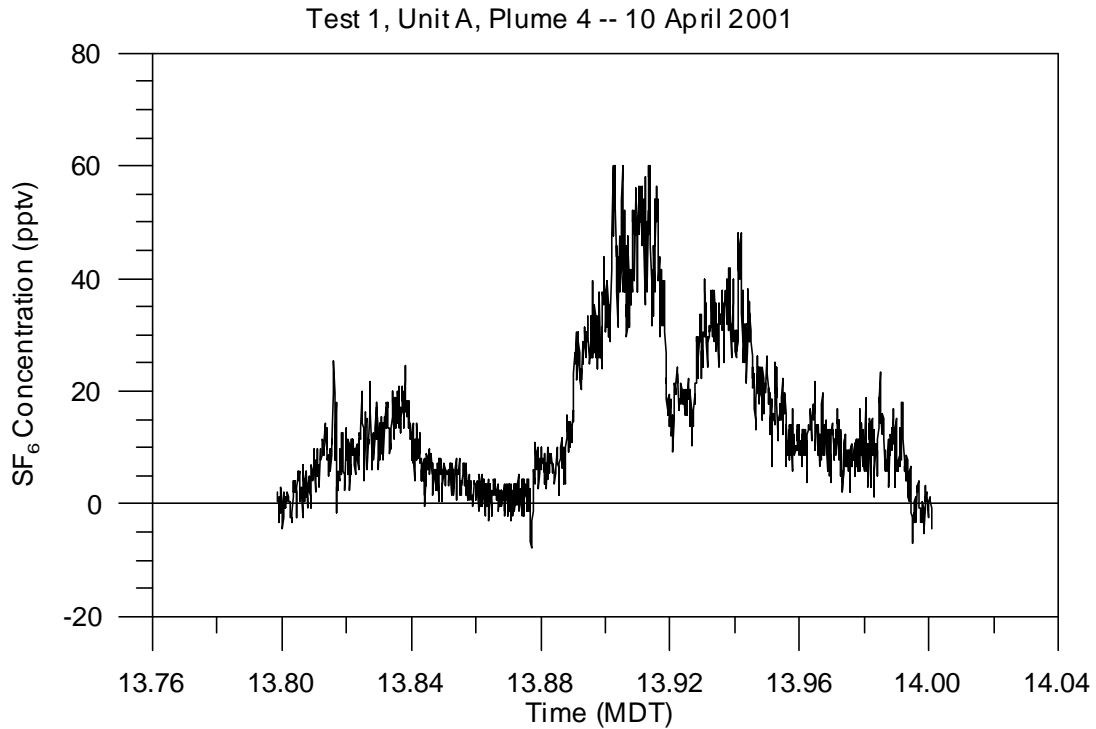


Figure A-9. SF₆ concentration of Plume 4 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

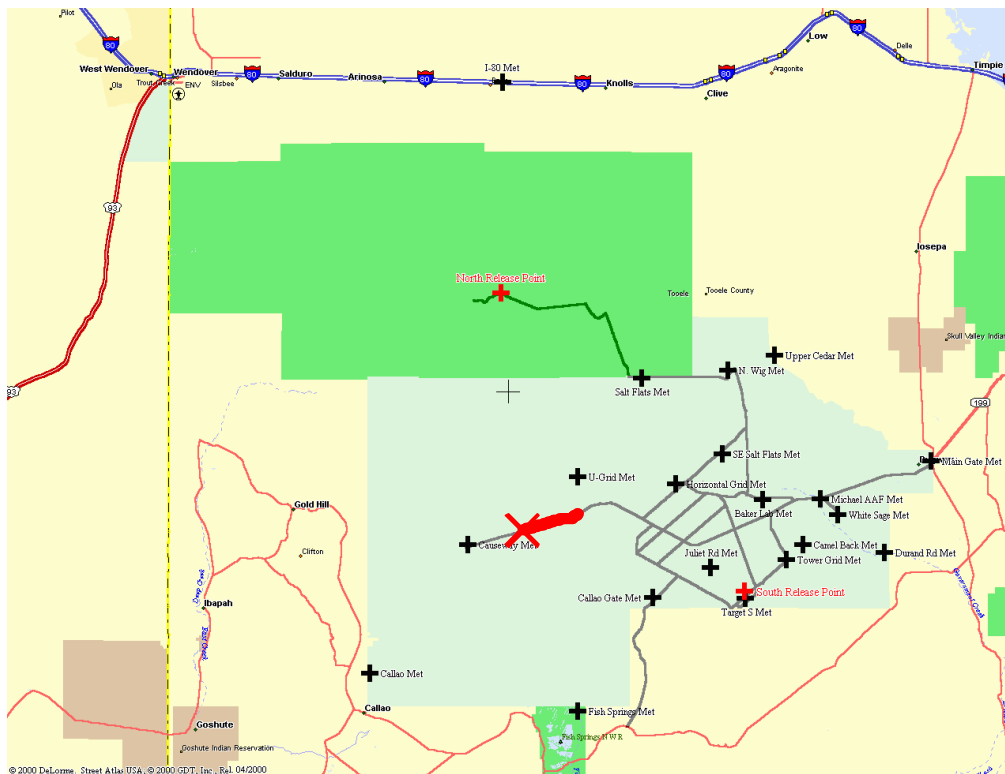
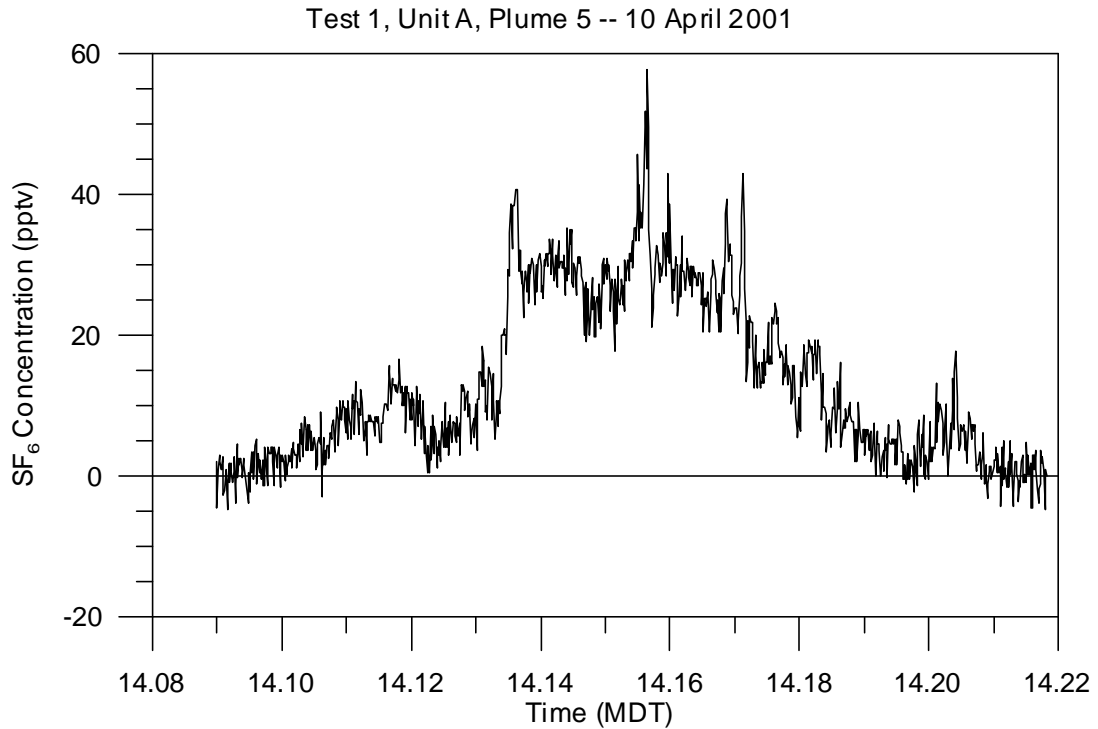


Figure A-10. SF₆ concentration of Plume 5 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

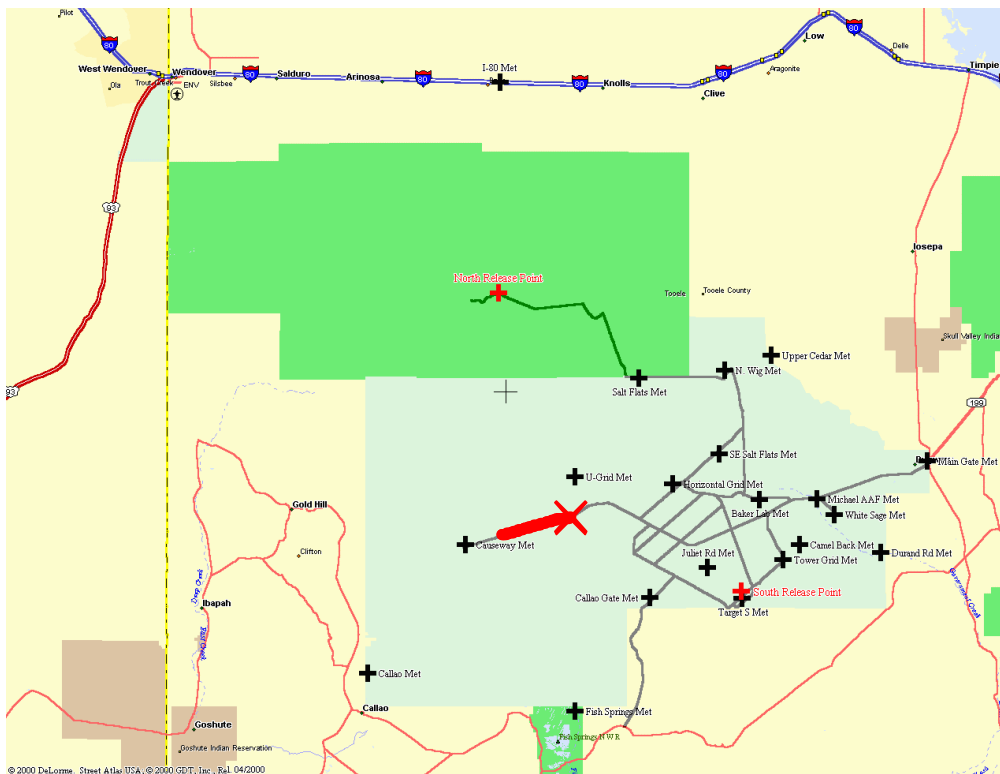
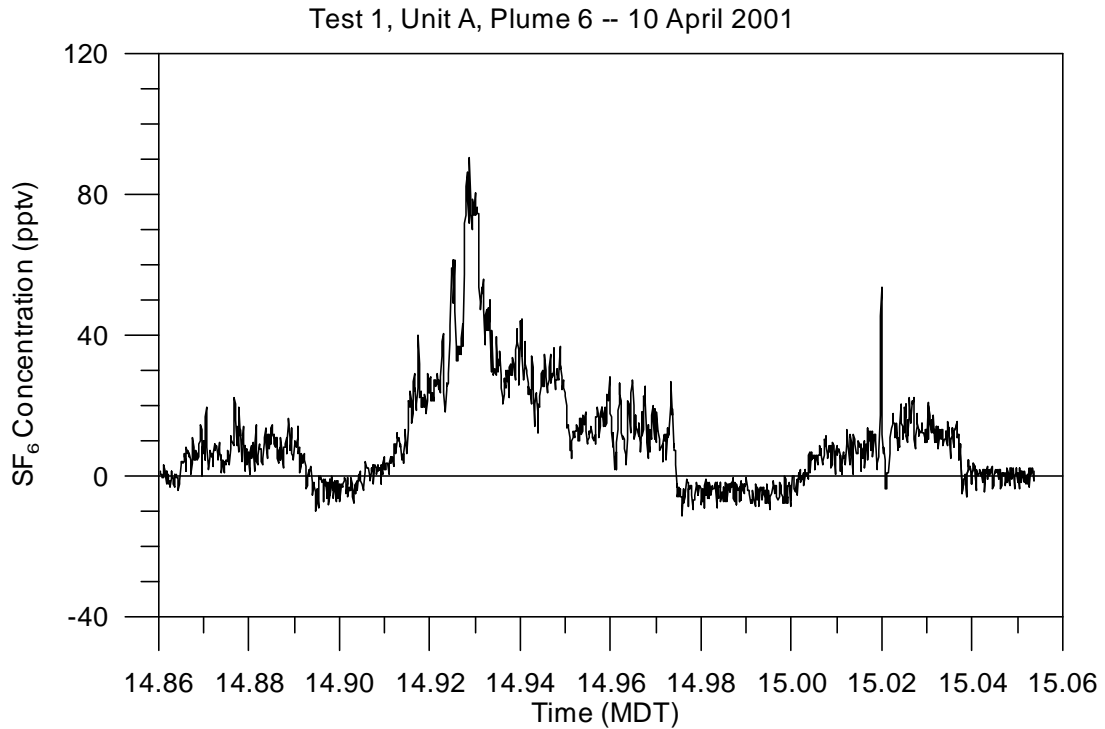


Figure A-11. SF₆ concentration of Plume 6 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

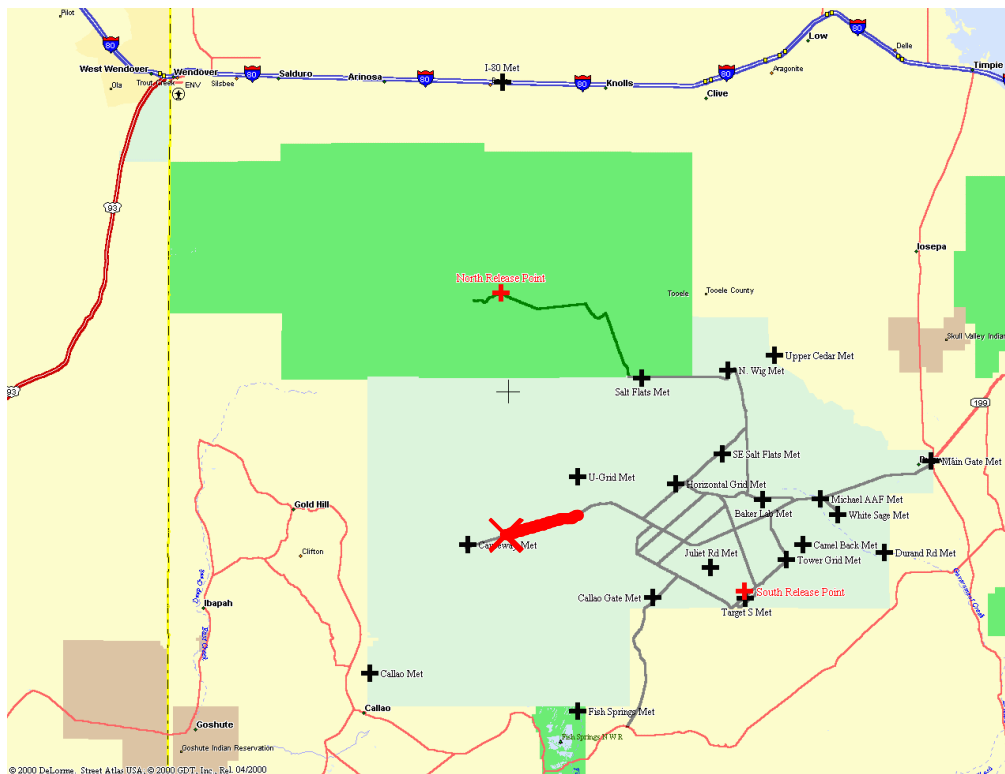
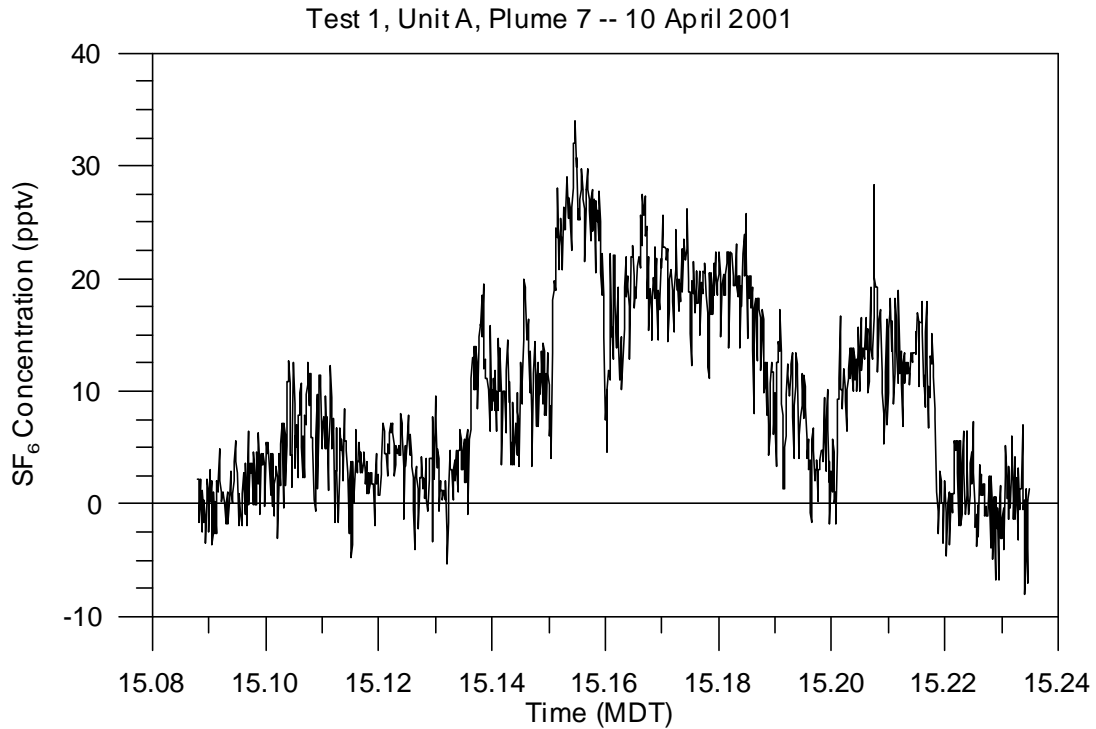


Figure A-12. SF₆ concentration of Plume 7 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

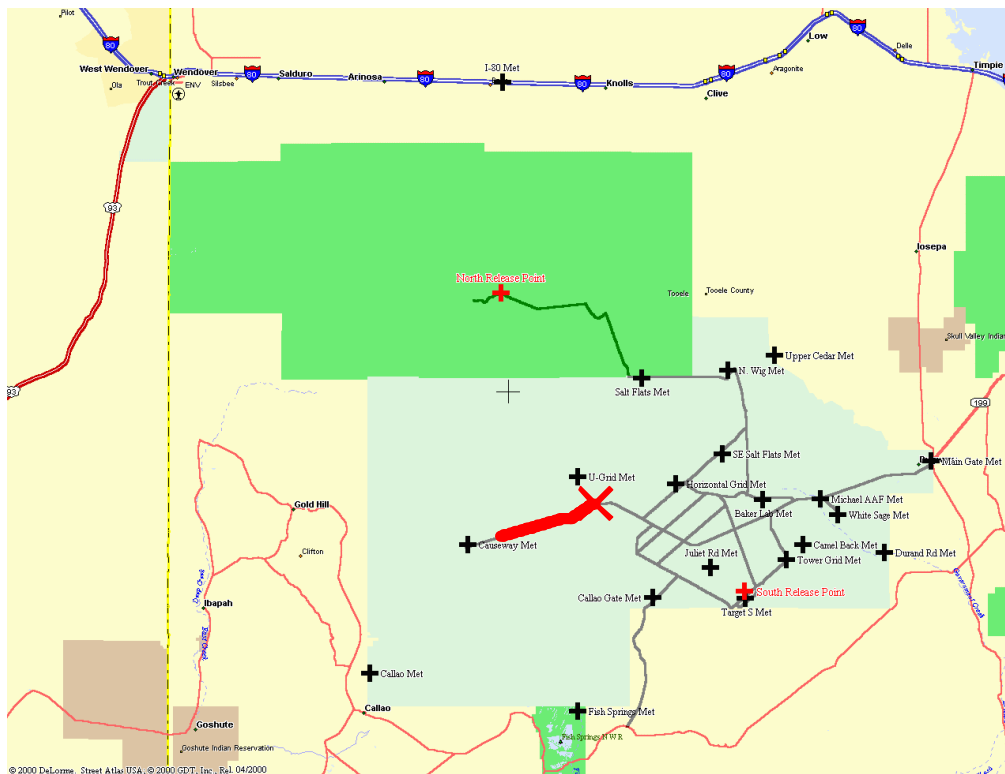
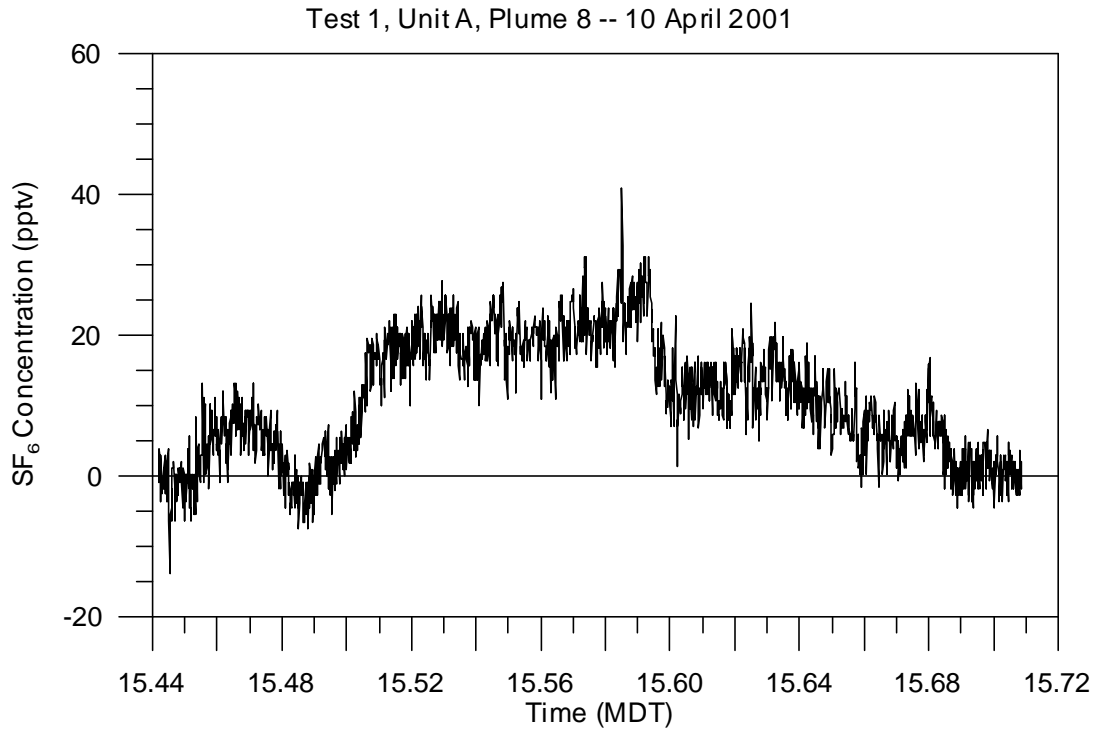


Figure A-13. SF₆ concentration of Plume 8 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

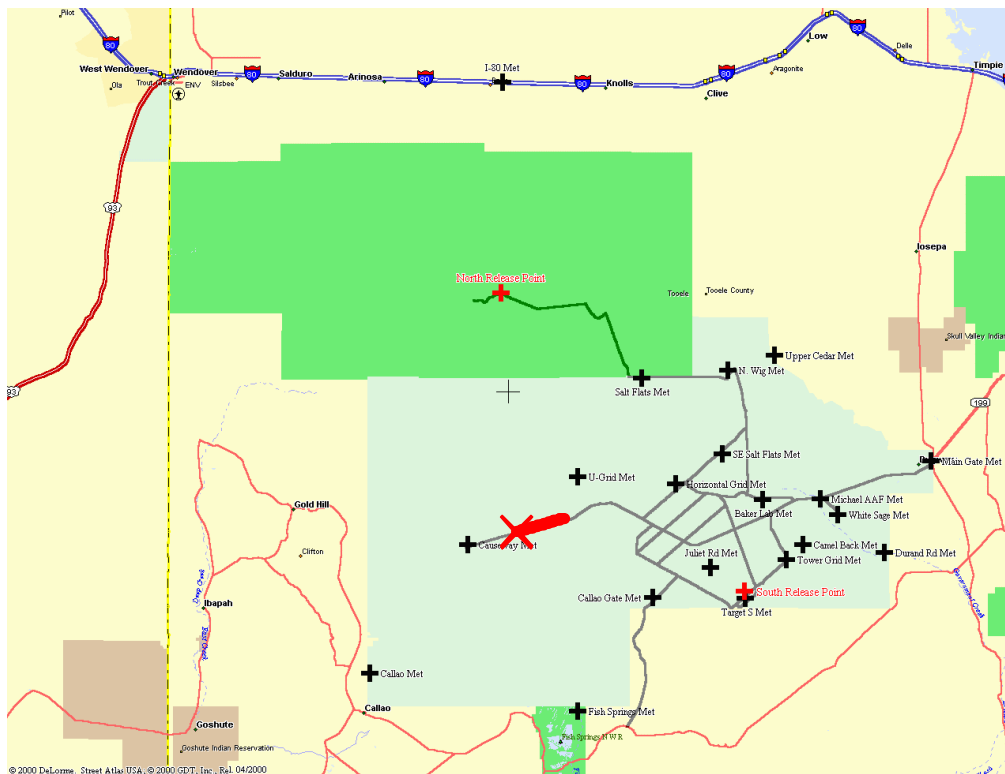
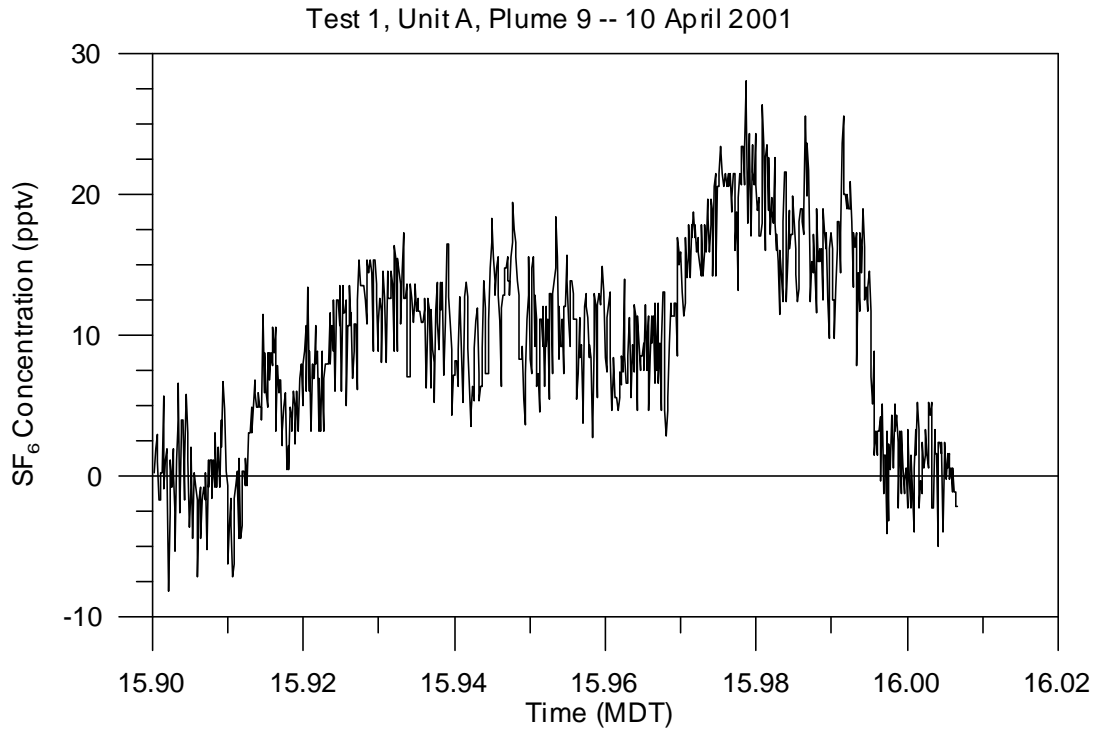


Figure A-14. SF₆ concentration of Plume 9 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

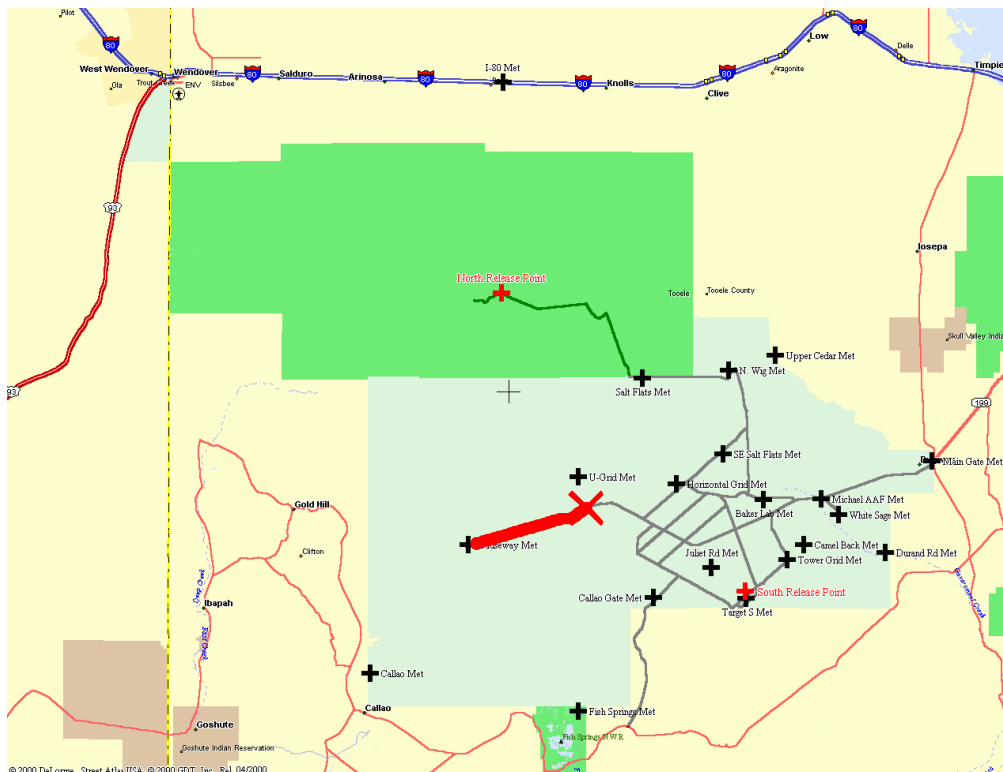
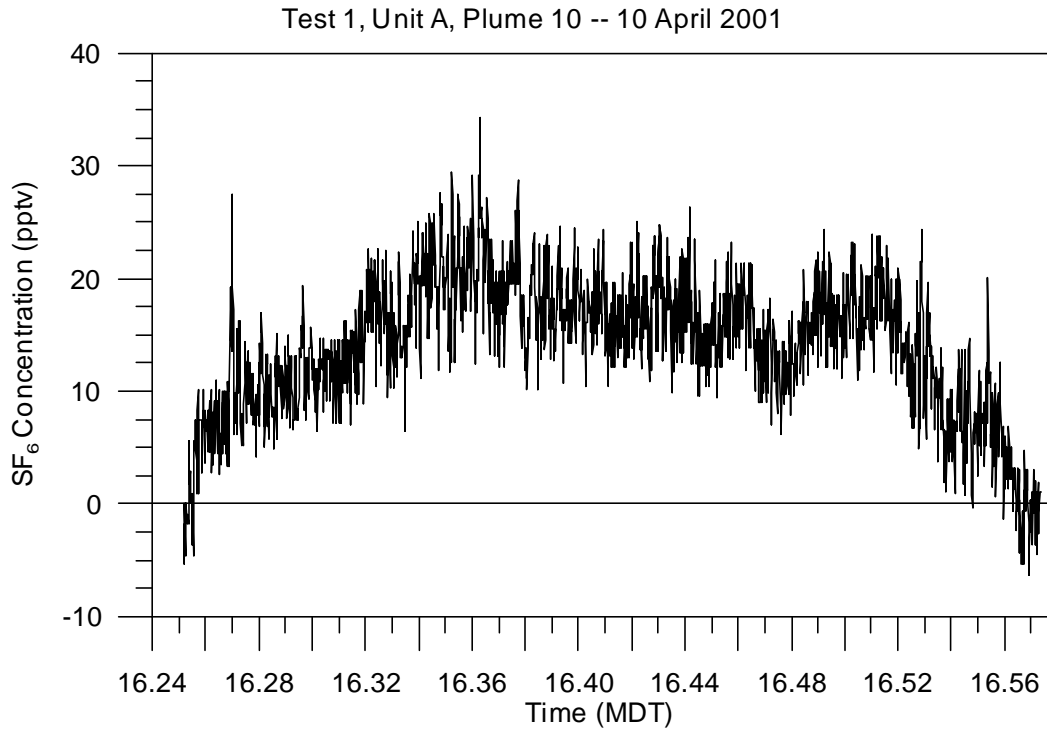


Figure A-15. SF₆ concentration of Plume 10 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

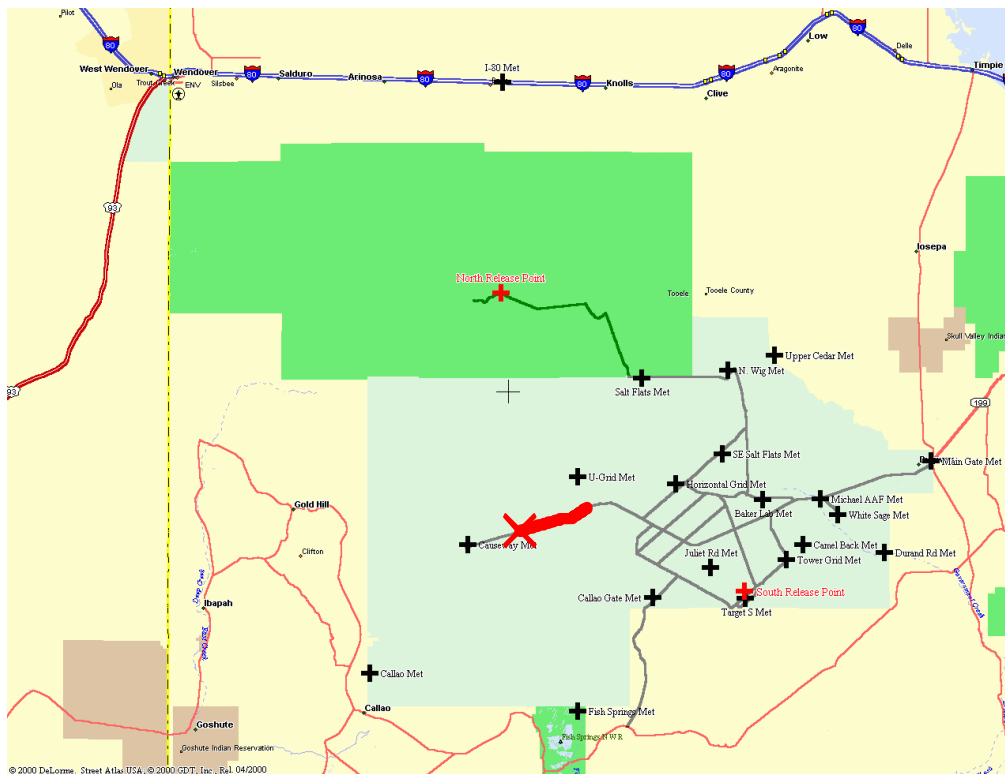
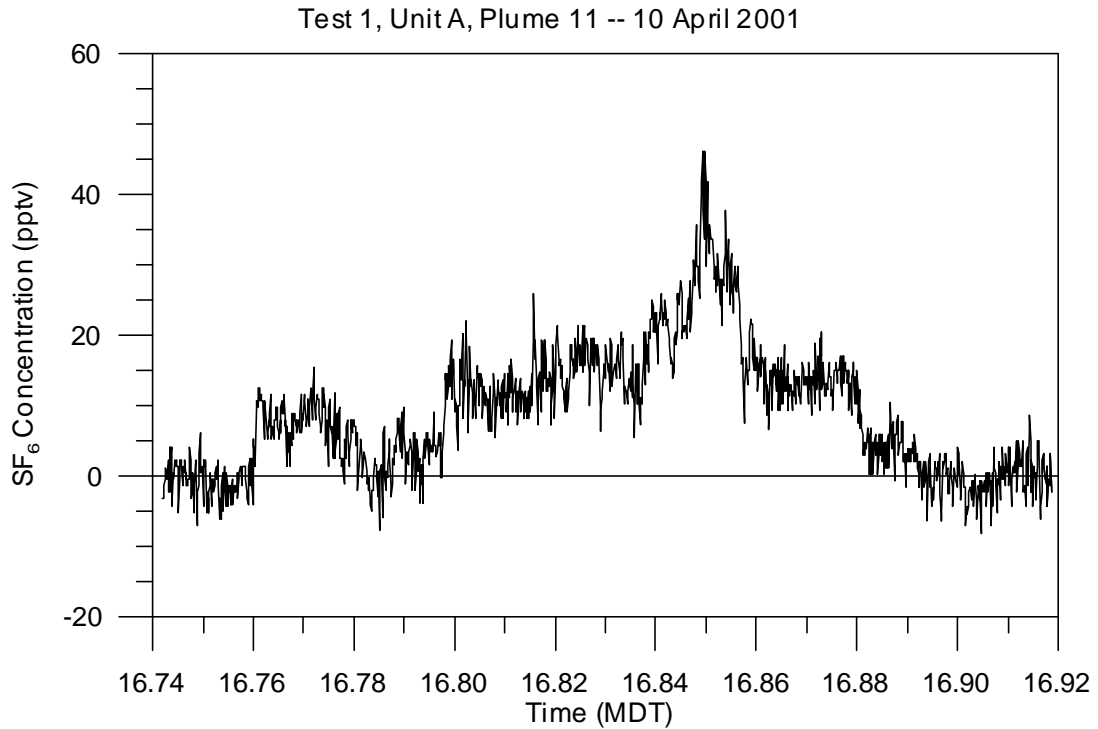


Figure A-16. SF₆ concentration of Plume 11 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

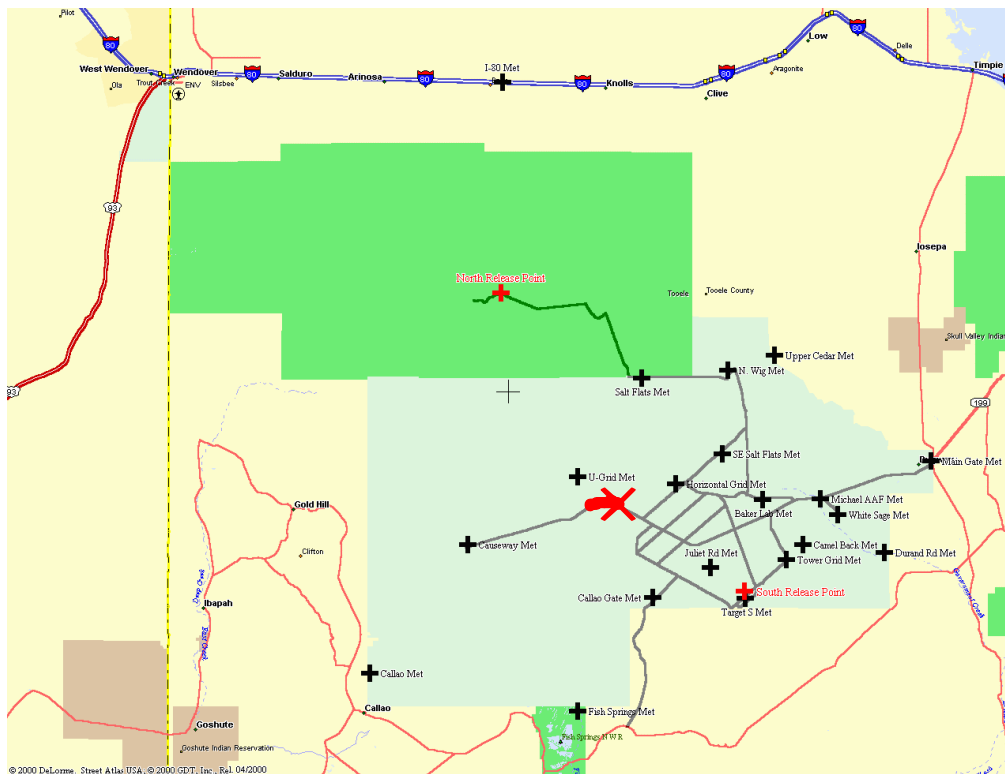
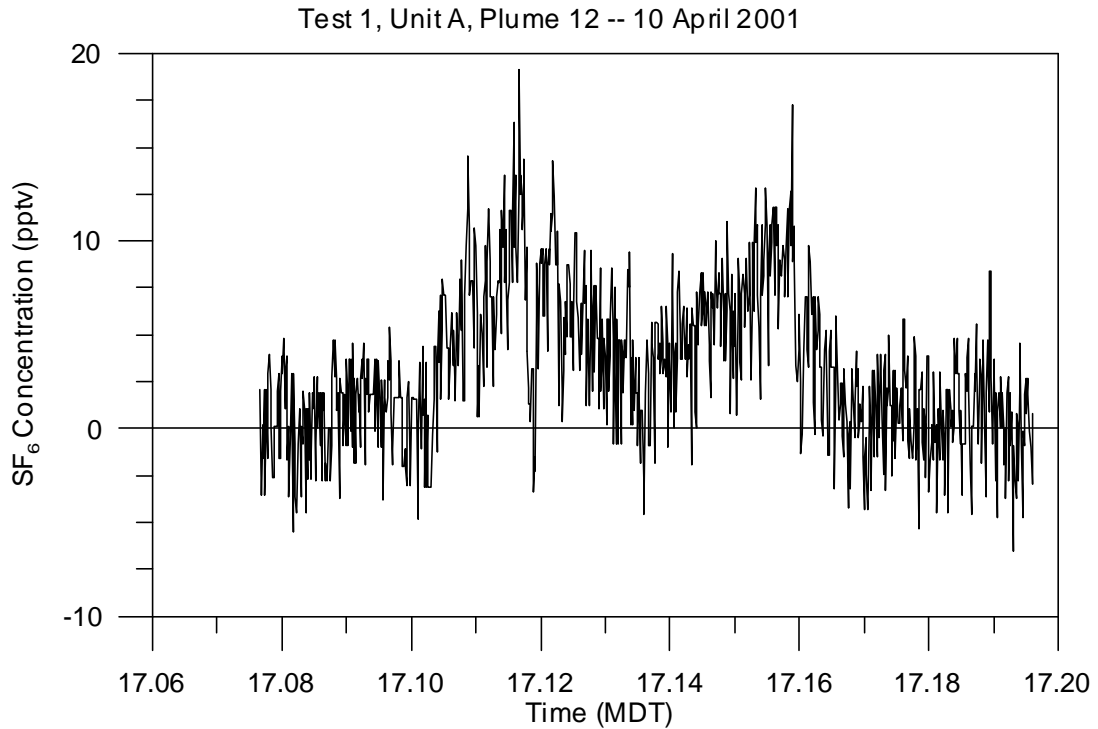


Figure A-17. SF₆ concentration of Plume 12 for Sampling Unit A during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 1 Sampling Unit B

Table A-8. Test 1 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	12:32	12:48
2	13:17	13:31
3	13:38	13:58

Table A-9. Summary of individual SF₆ plume characteristics measured by Sampling Unit B during Test 1. Bearings and ranges are given to the North Release Point (TS-5).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	14:02-14:17	1764	175.4-184.9	61.66	64.64	67.95
2	14:17-14:28	1363	174.7-175.6	63.66	66.20	68.81
3	14:38-15:16	4534	160.3-171.2	61.96	66.67	69.69
4	16:12-16:38	3038	158.8-168.2	58.04	64.45	68.43
5	16:53-16:57	563	174.1-174.8	68.47	69.52	70.58
6	17:44-18:09	2985	155.5-170.3	50.85	61.25	69.64

Table A-10. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the North Release Point (TS-5) of each individual plume traverse measured by Sampling Unit B during Test 1.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	26.8	14:08	39.863357	113.472577	180.0	65.41
2	17.3	14:25	39.849637	113.410995	175.5	67.14
3	38.9	14:41	39.838930	113.318803	169.2	69.36
4	17.6	16:28	39.879515	113.265540	164.6	66.00
5	15.5	16:56	39.834072	113.397295	174.7	68.96
6	27.9	18:01	39.967933	113.225360	158.7	57.74

No null passes were made by Sampling Unit B either during or after the time period of active plume sampling listed in the previous two tables.

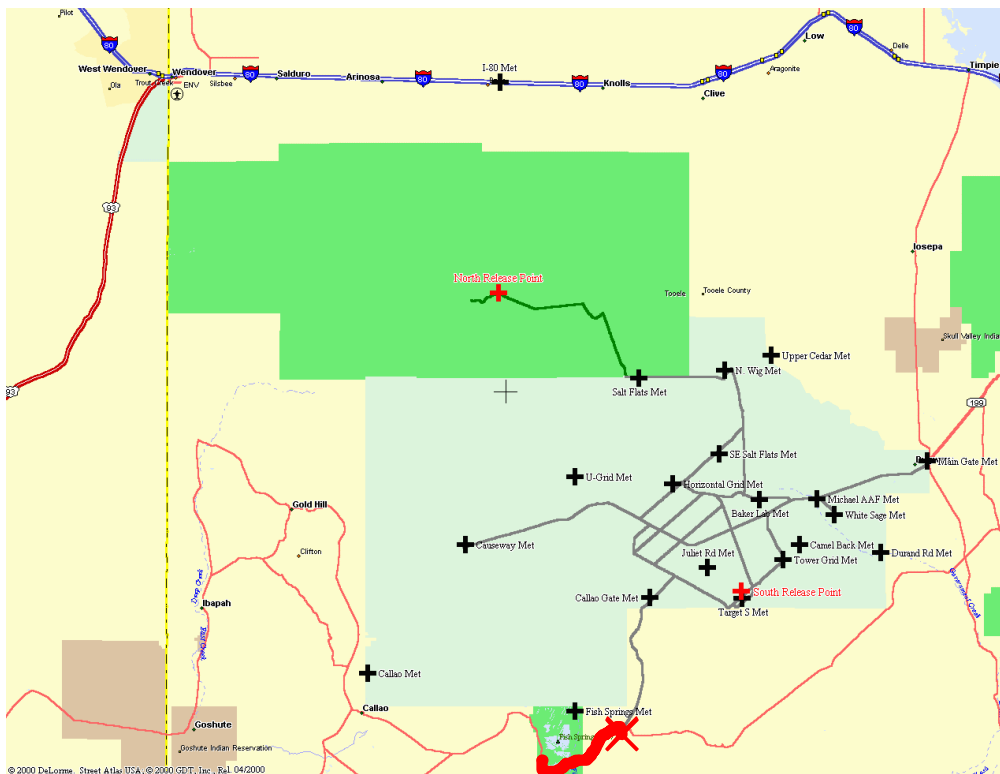
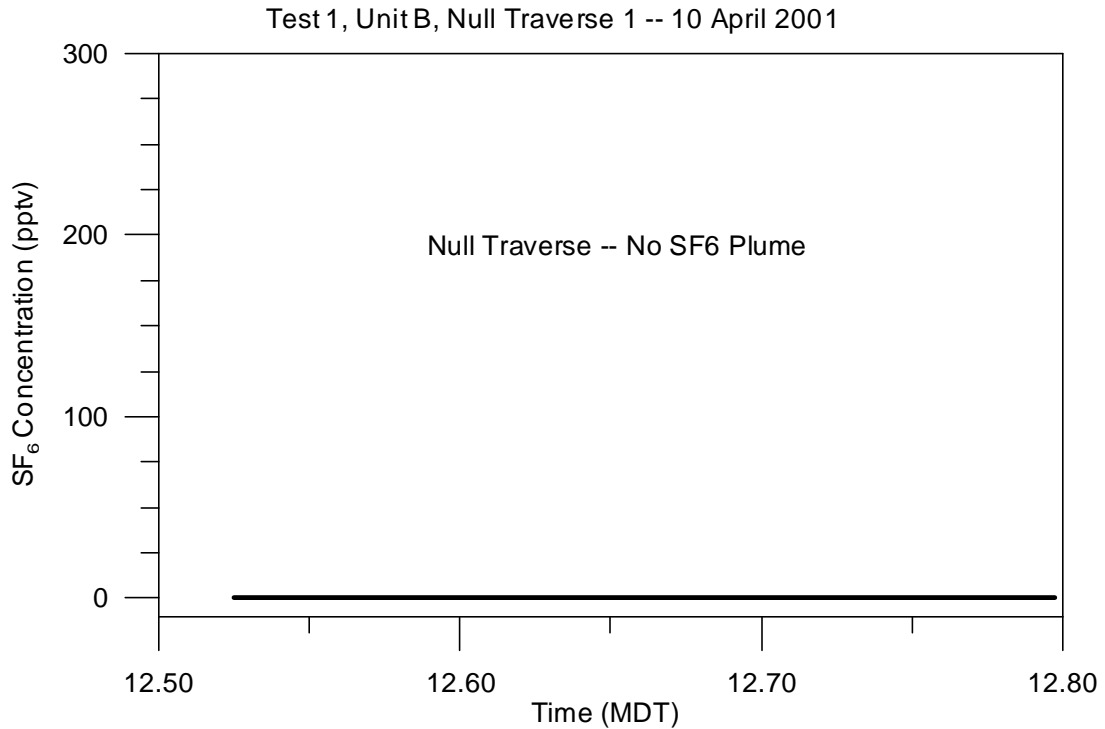


Figure A-18. Null sampling traverse 1 made by Sampling Unit B during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

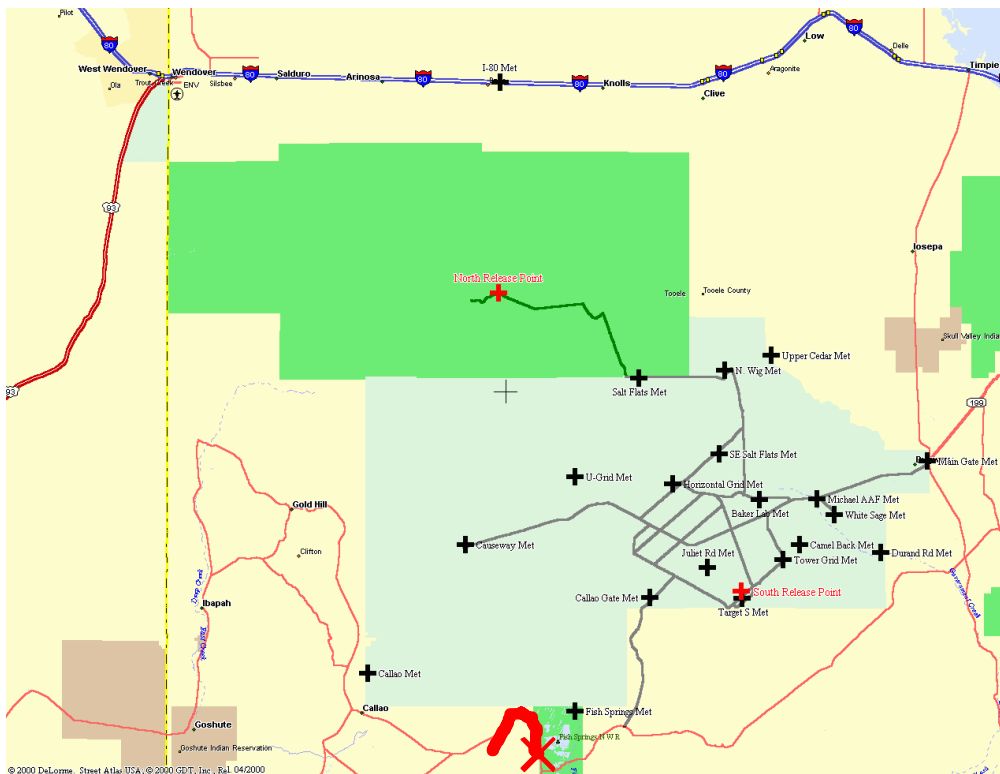
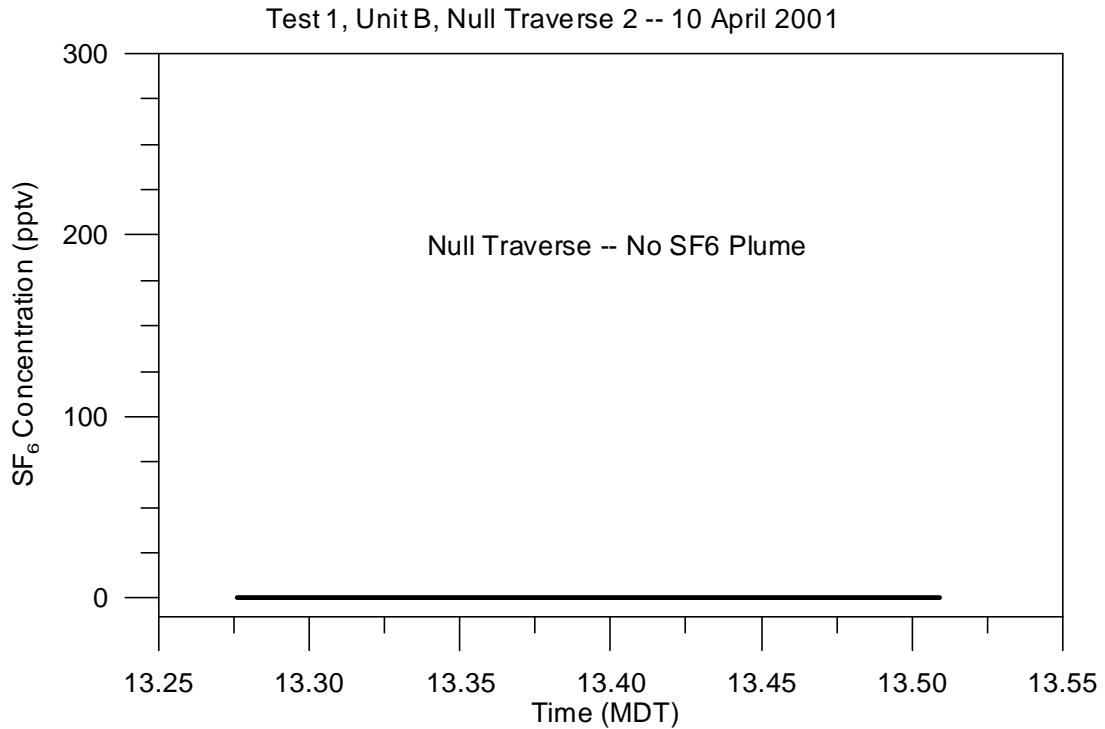


Figure A-19. Null sampling traverse 2 made by Sampling Unit B during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

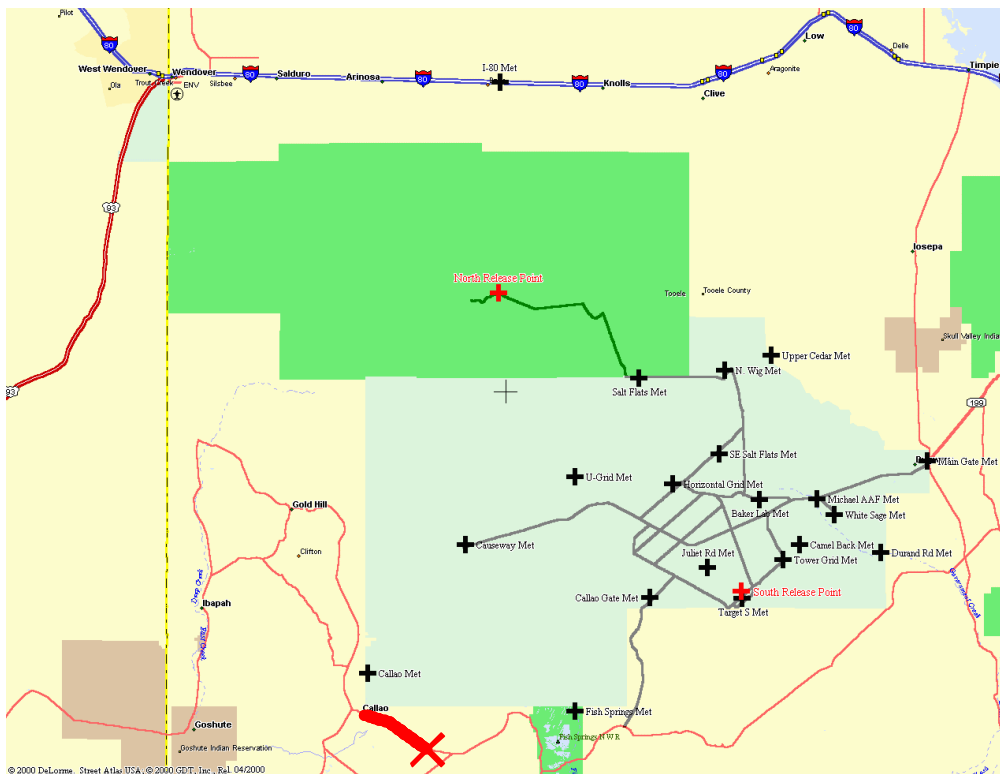
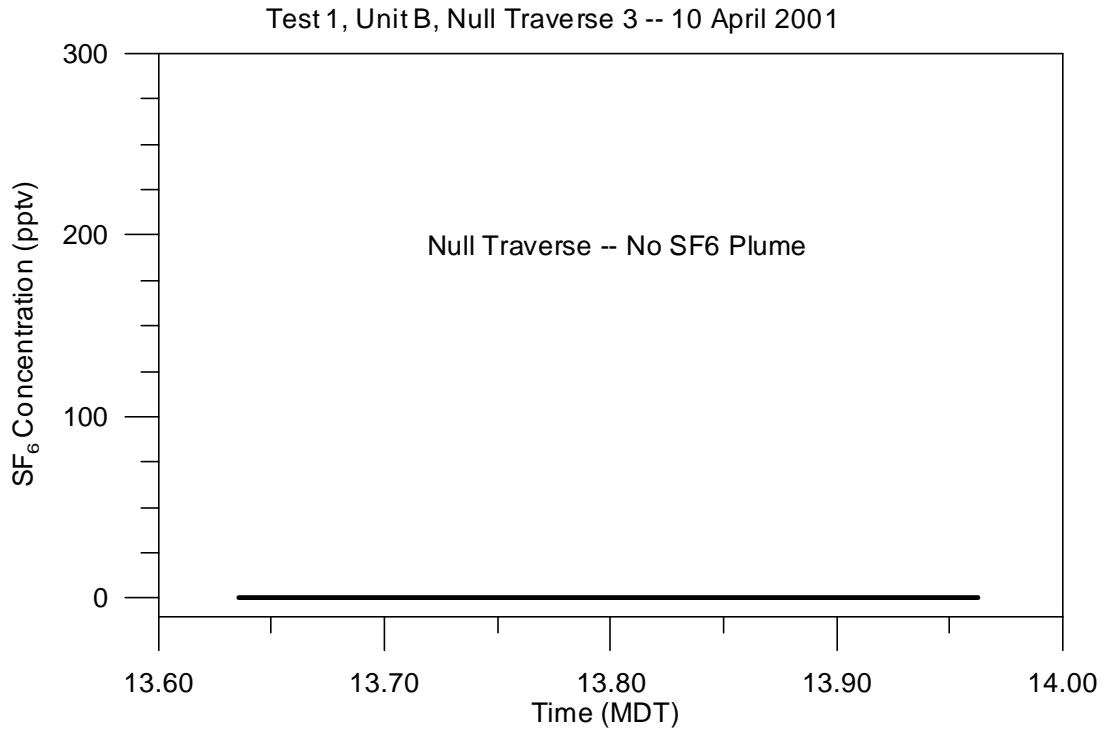


Figure A-20. Null sampling traverse 3 made by Sampling Unit B during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

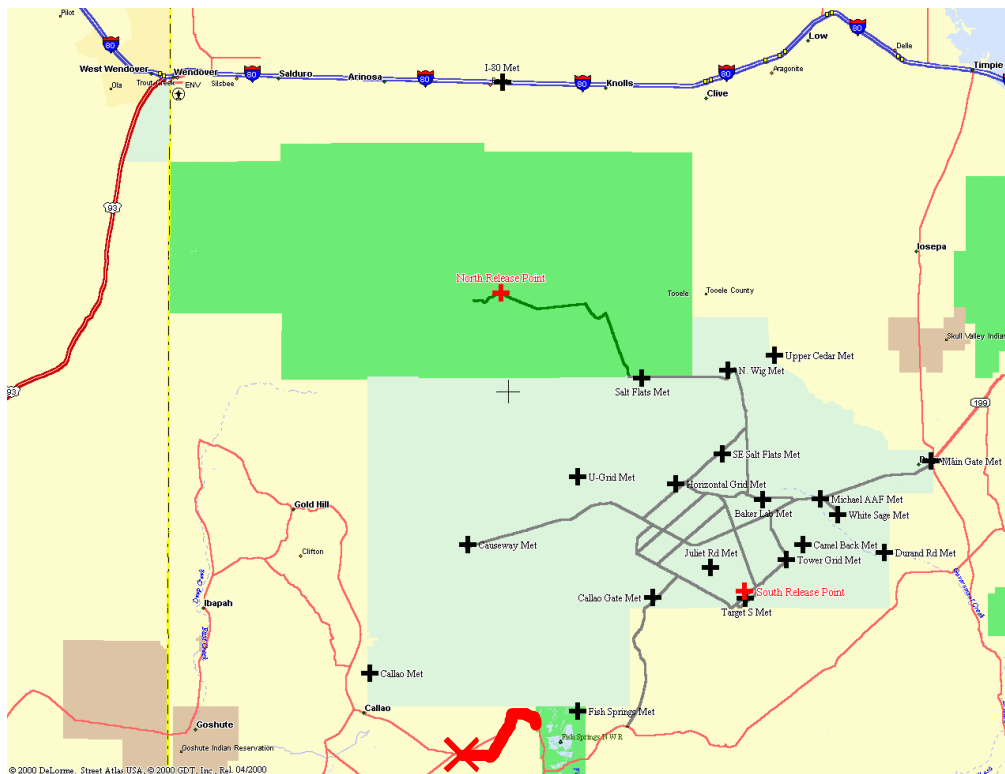
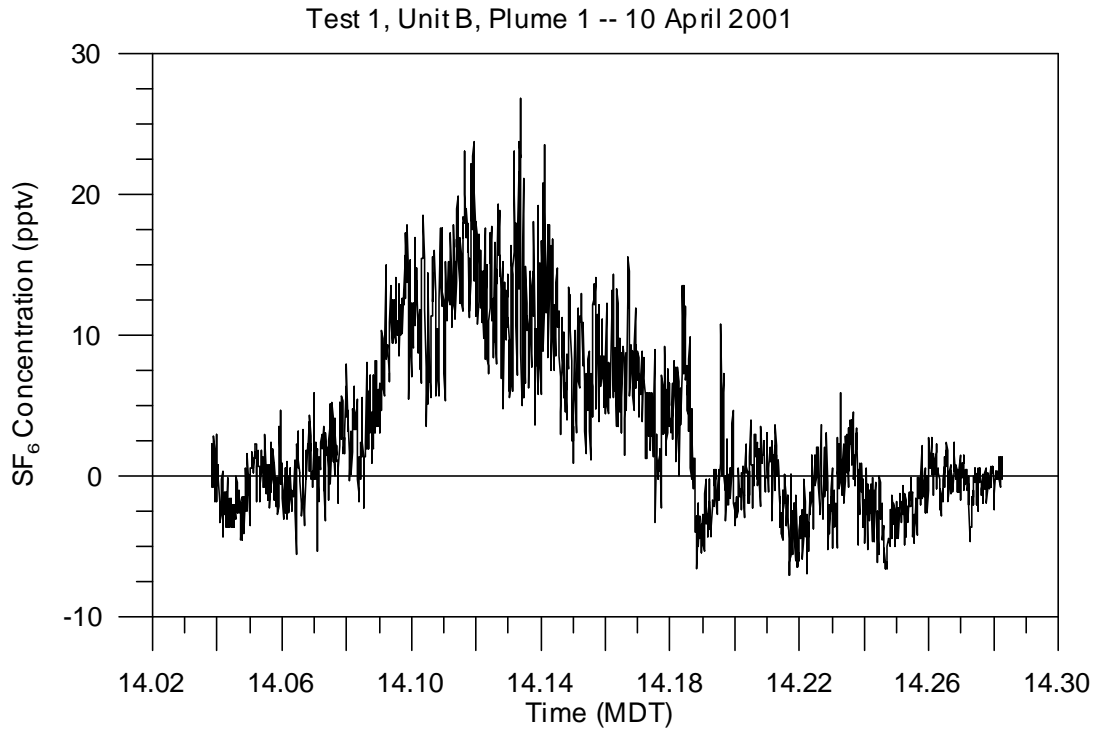


Figure A-21. SF₆ concentration of Plume 1 for Sampling Unit B during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

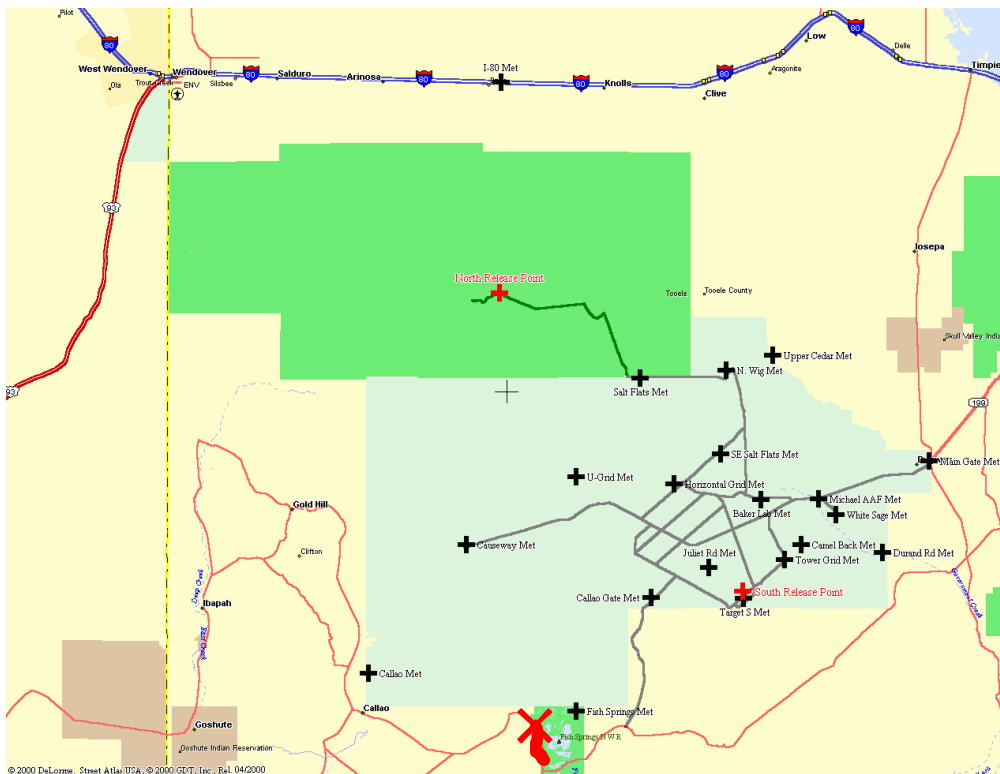
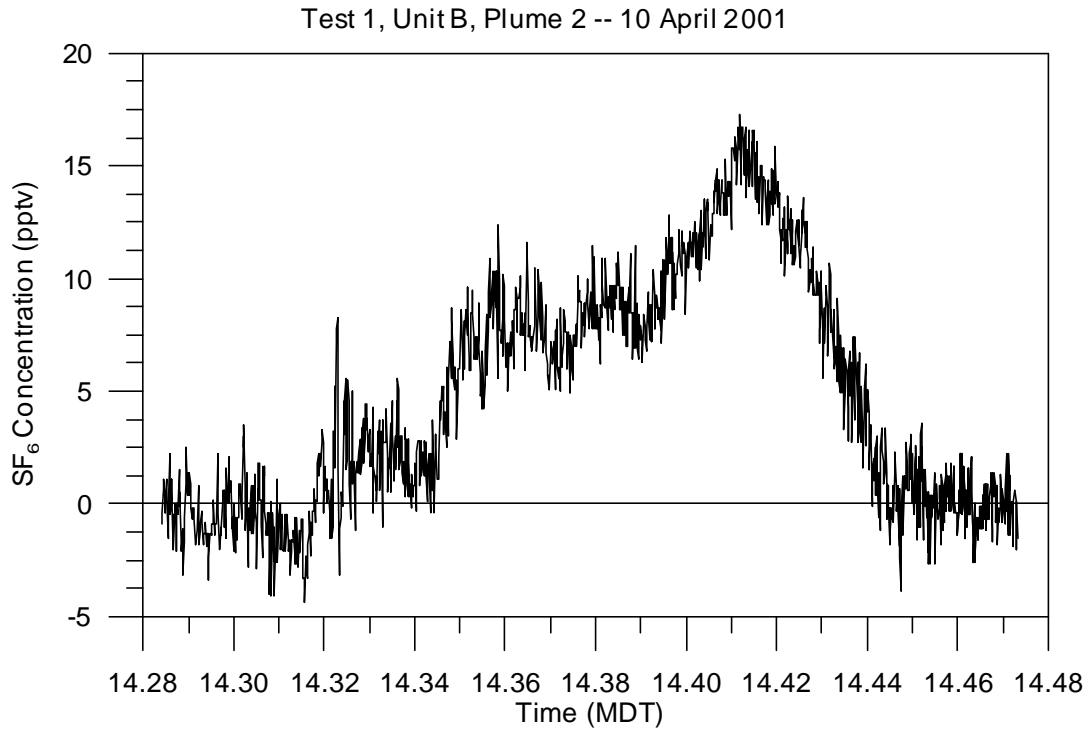


Figure A-22. SF₆ concentration of Plume 2 for Sampling Unit B during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

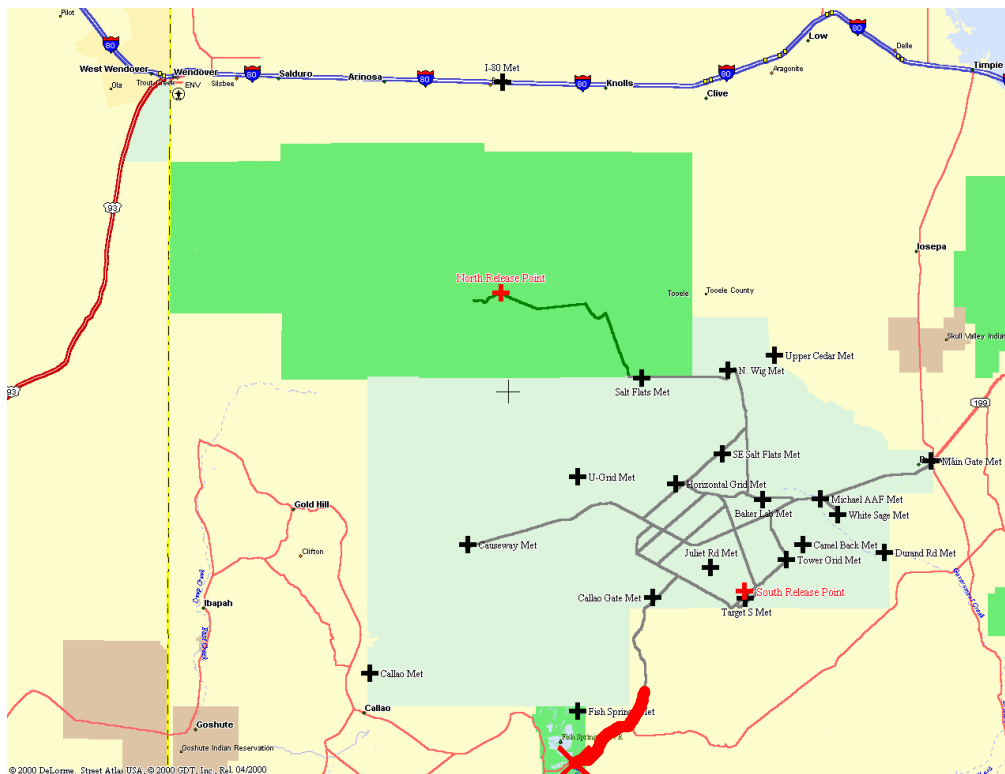
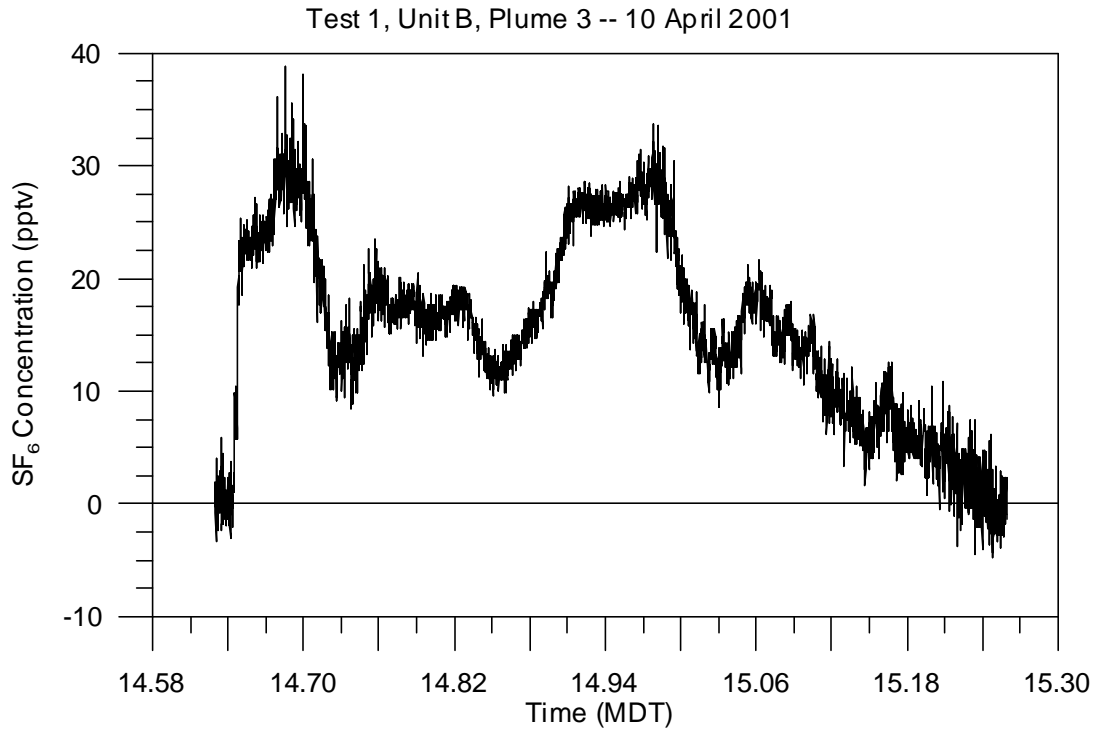


Figure A-23. SF₆ concentration of Plume 3 for Sampling Unit B during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

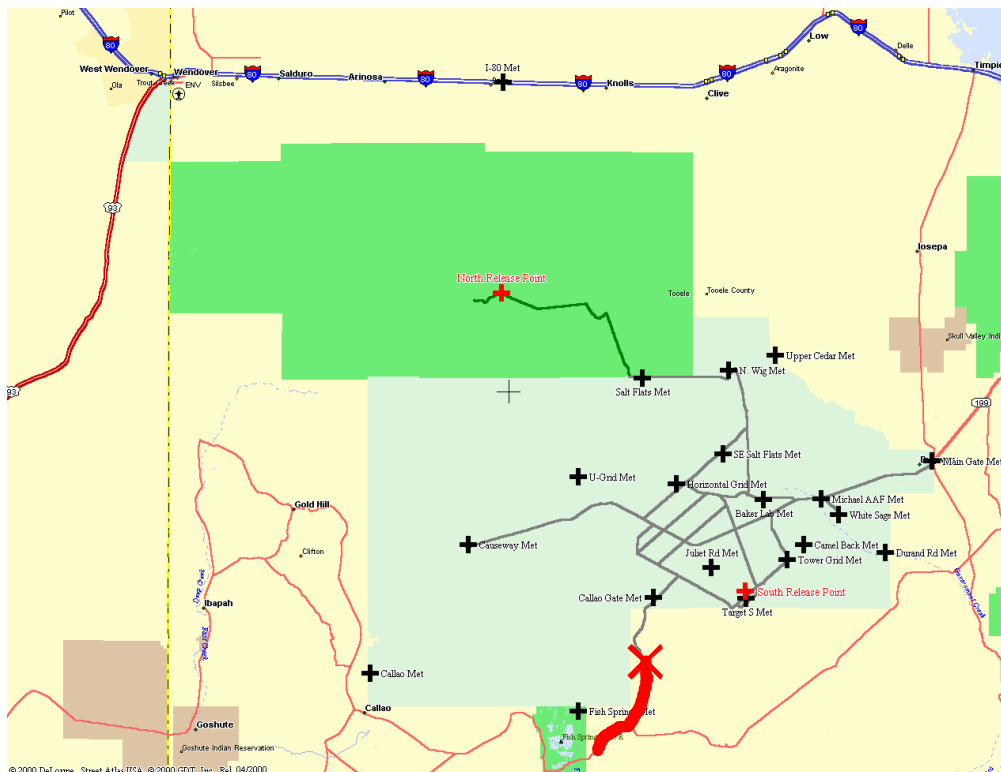
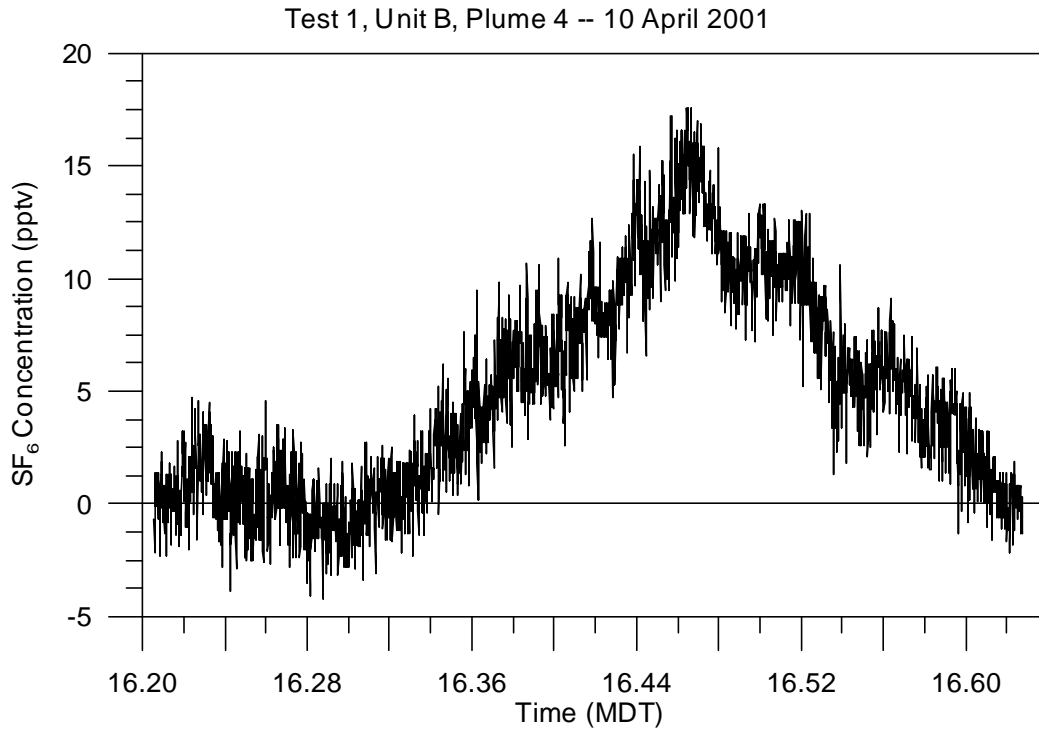


Figure A-24. SF₆ concentration of Plume 4 for Sampling Unit B during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

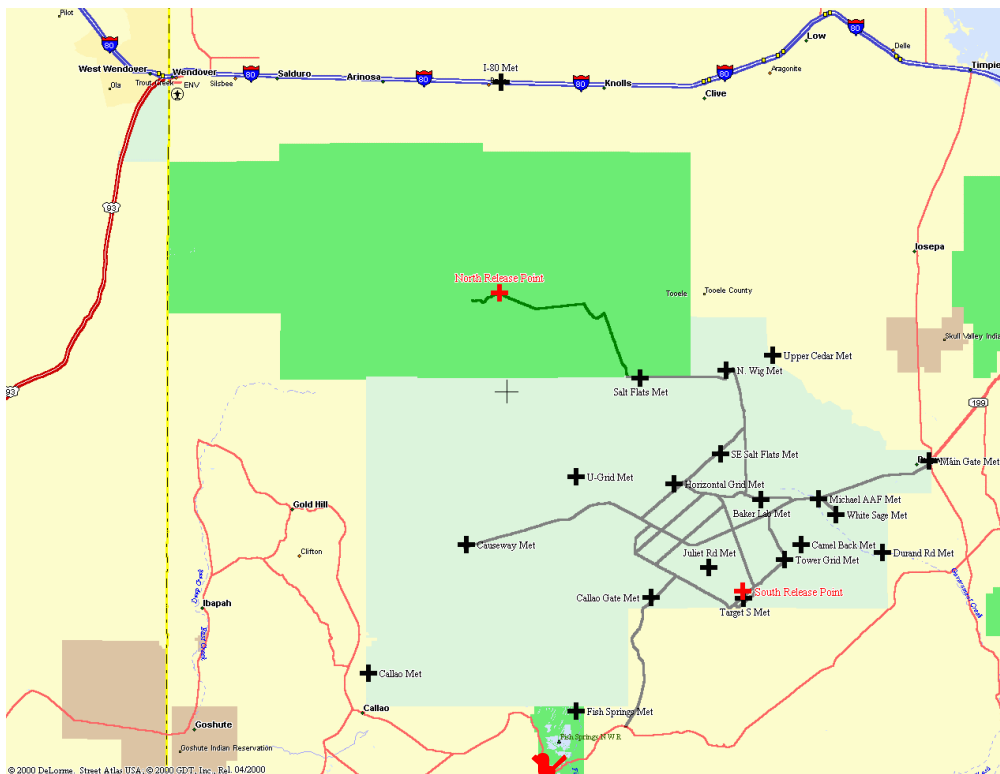
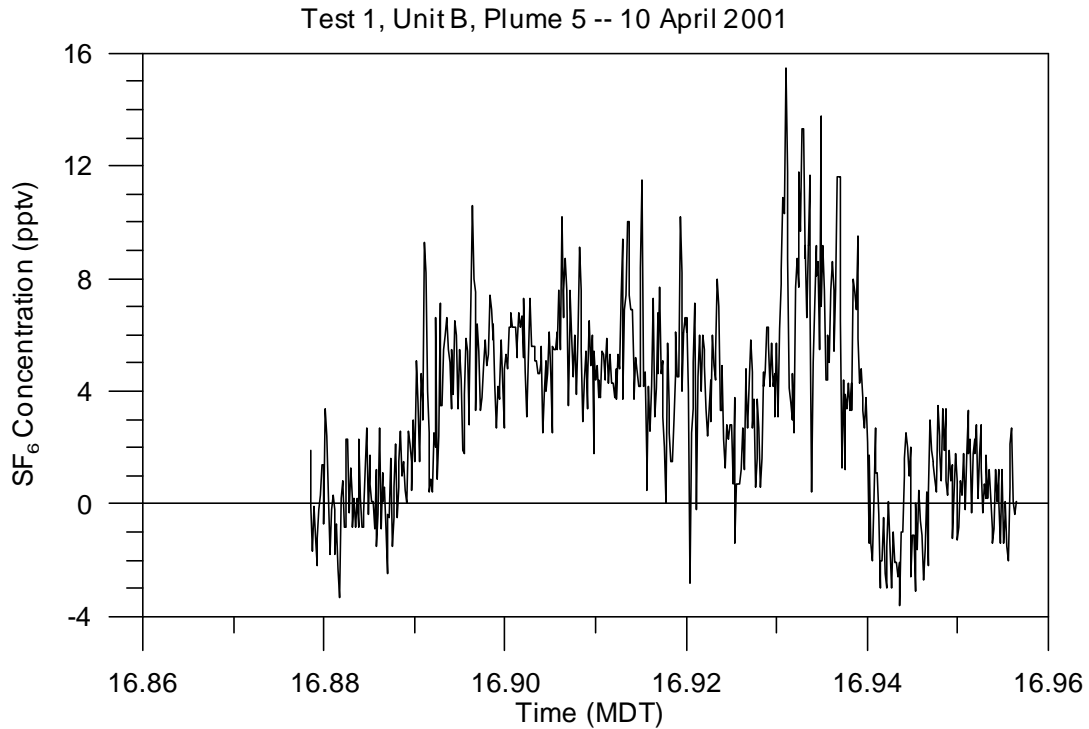


Figure A-25. SF₆ concentration of Plume 5 for Sampling Unit B during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

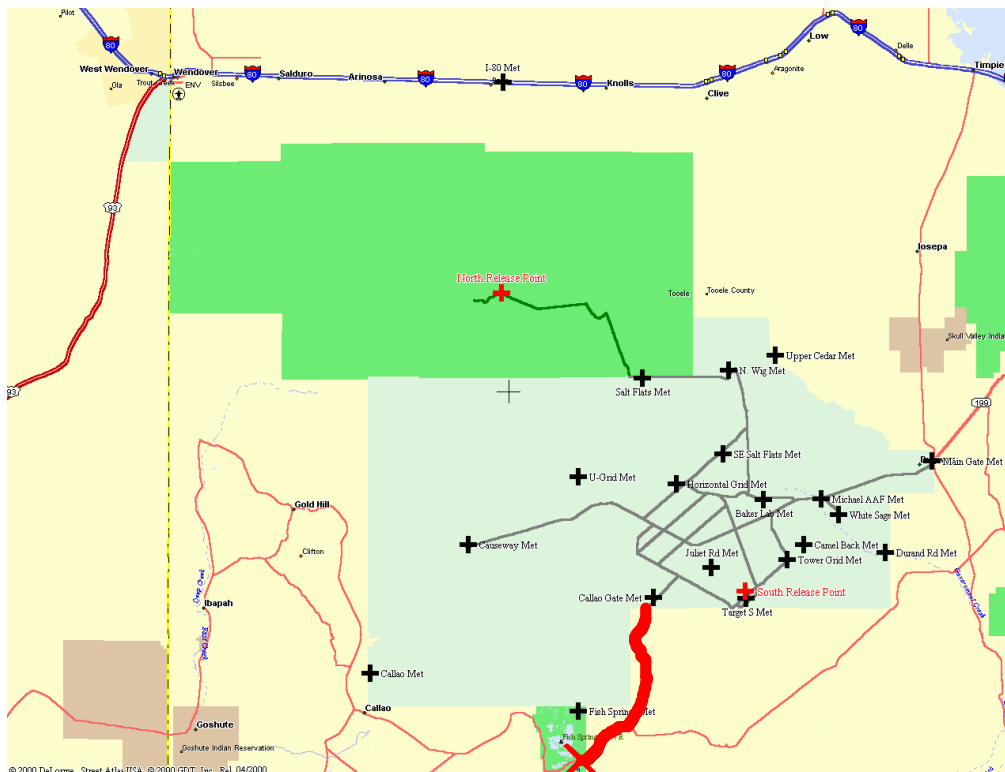
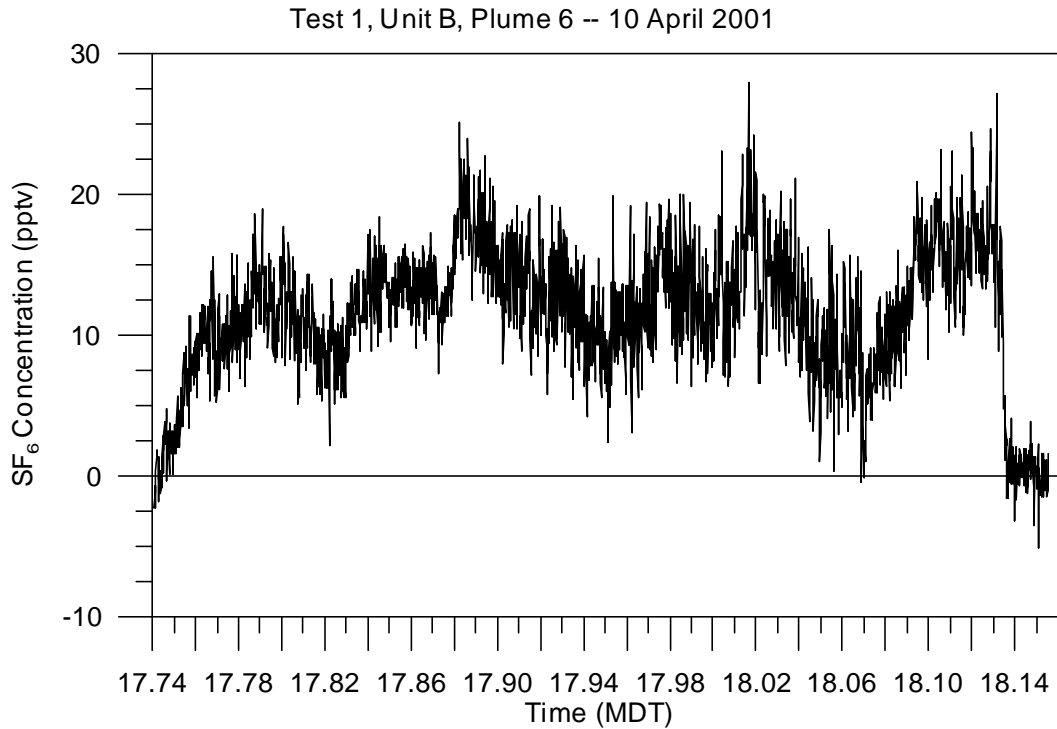


Figure A-26. SF₆ concentration of Plume 6 for Sampling Unit B during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 1 Sampling Unit C

Table A-11. Test 1 Sampling Unit C sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	12:02	12:19
2	12:57	13:07
3	13:08	13:44
4	13:49	14:15
5	14:26	14:49

Table A-12. Summary of individual SF₆ plume characteristics measured by Sampling Unit C during Test 1. Bearings and ranges are given to the North Release Point (TS-5).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	14:51-15:01	1278	167.4-169.9	67.18	67.77	69.64
2	15:07-15:21	1619	174.4-175.6	62.88	68.10	70.51
3	16:19-16:22	407	174.8-175.6	65.76	67.06	68.23
4	16:30-16:59	3461	159.2-171.5	59.76	66.31	69.74

Table A-13. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the North Release Point (TS-5) of each individual plume traverse measured by Sampling Unit C during Test 1.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	32.6	14:56	39.861998	113.299817	167.4	67.18
2	25.3	15:16	39.844048	113.405227	175.2	67.79
3	14.9	16:21	39.851410	113.410697	175.5	66.94
4	21.7	16:50	39.885222	113.250128	163.3	65.75

Table A-14. Test 1 Sampling Unit C sampling traverses yielding no detectable SF₆ (null pass) during SF₆ plume encounters.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
6	15:24	15:47
7	15:53	16:14

No null passes were made by Sampling Unit C after the time period of active plume sampling listed in Tables 12 and 13.

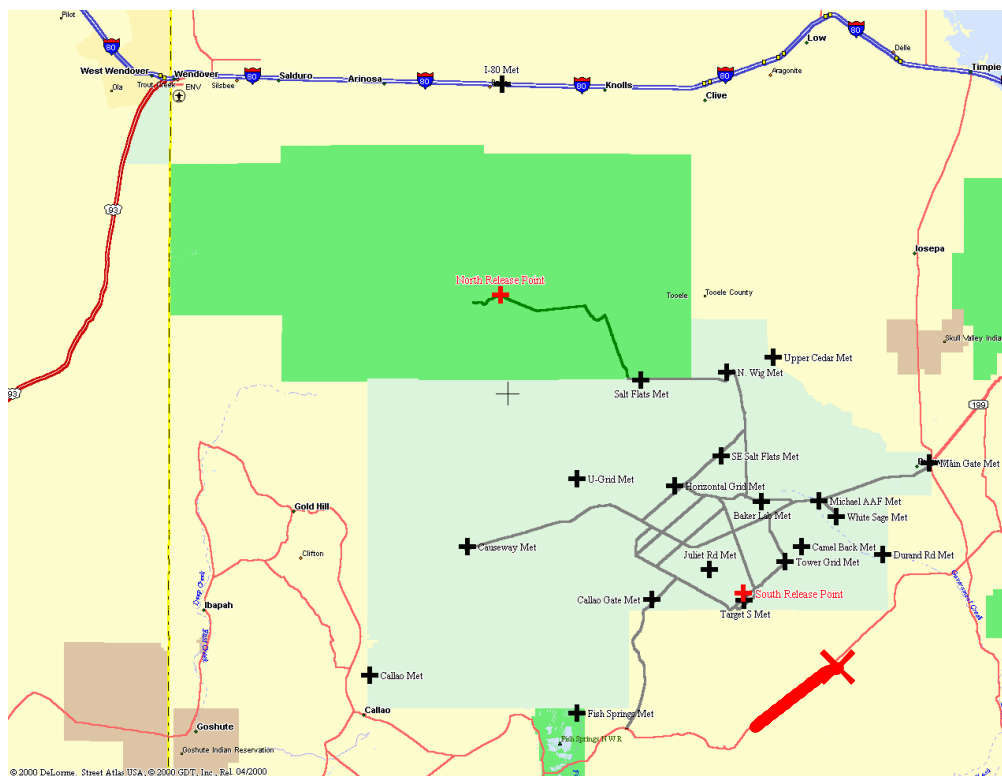
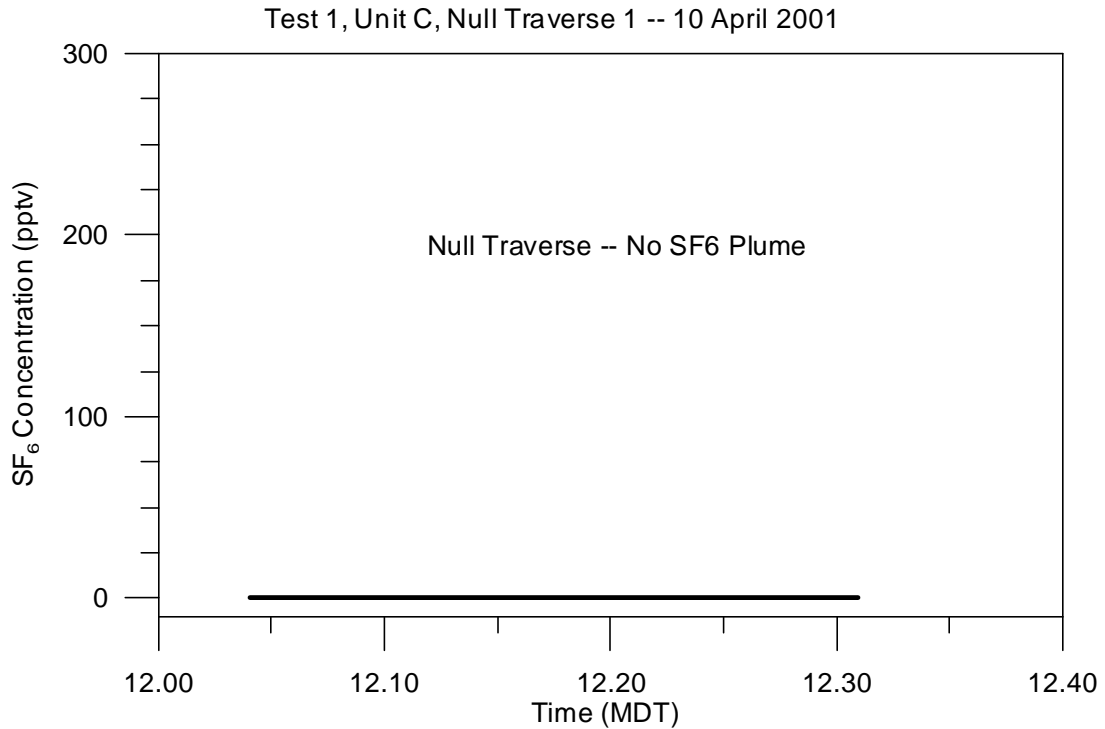


Figure A-27. Null sampling traverse 1 made by Sampling Unit C during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

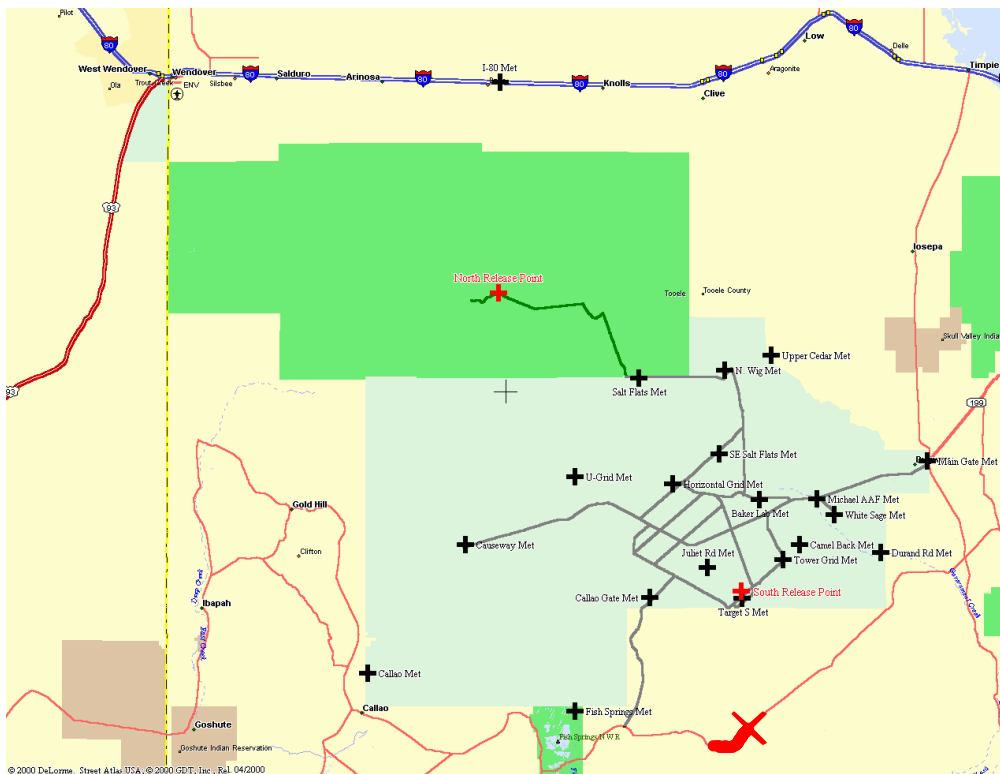
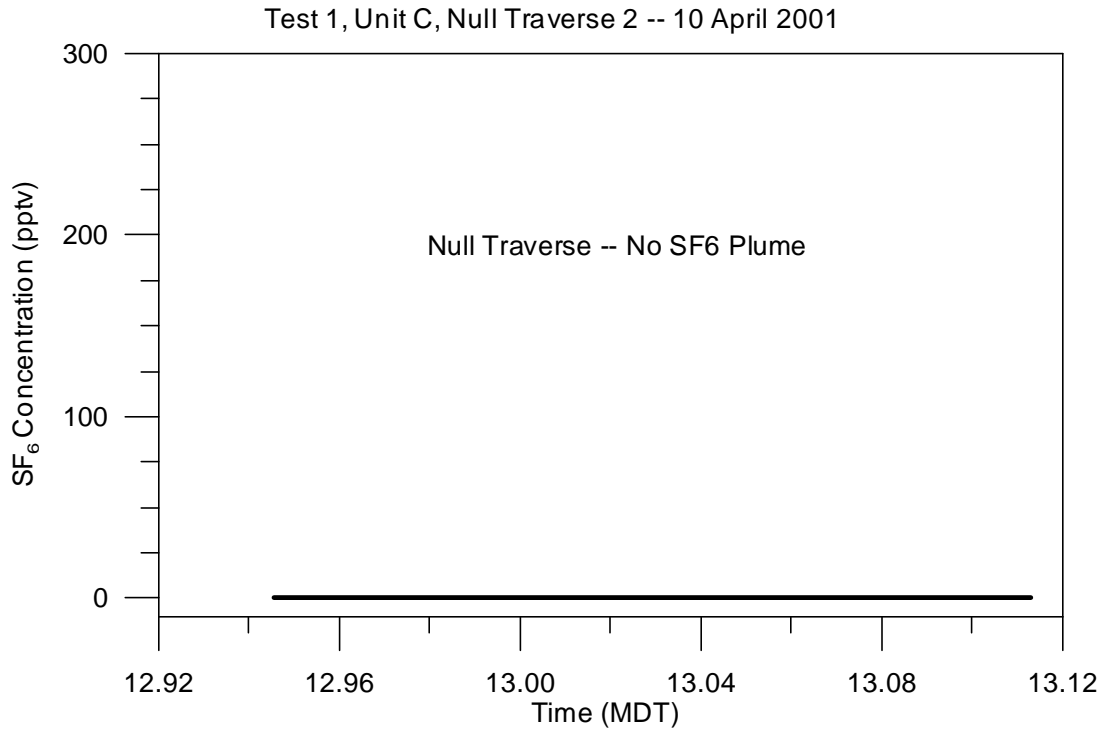


Figure A-28. Null sampling traverse 2 made by Sampling Unit C during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

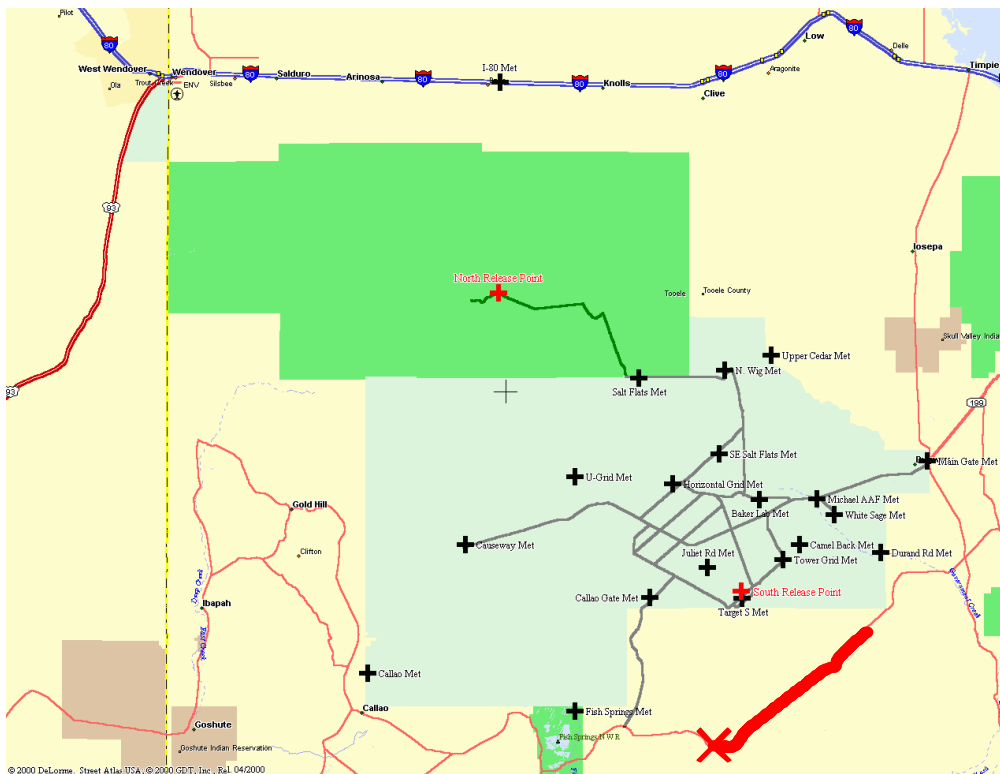
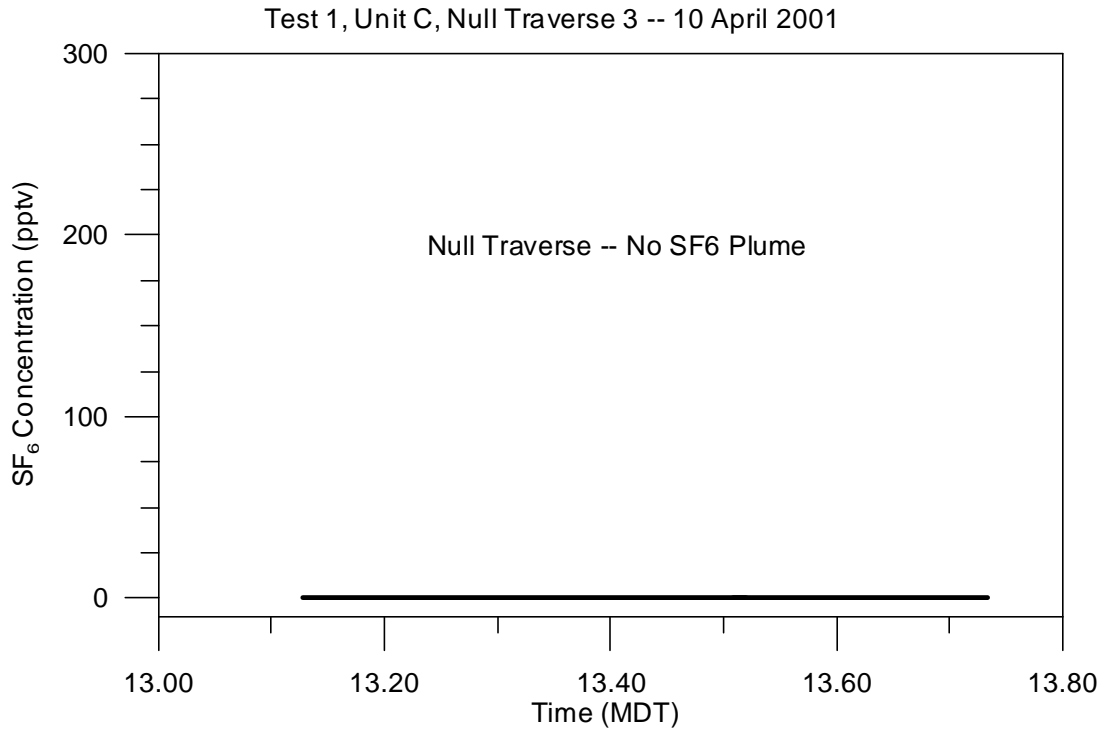


Figure A-29. Null sampling traverse 3 made by Sampling Unit C during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

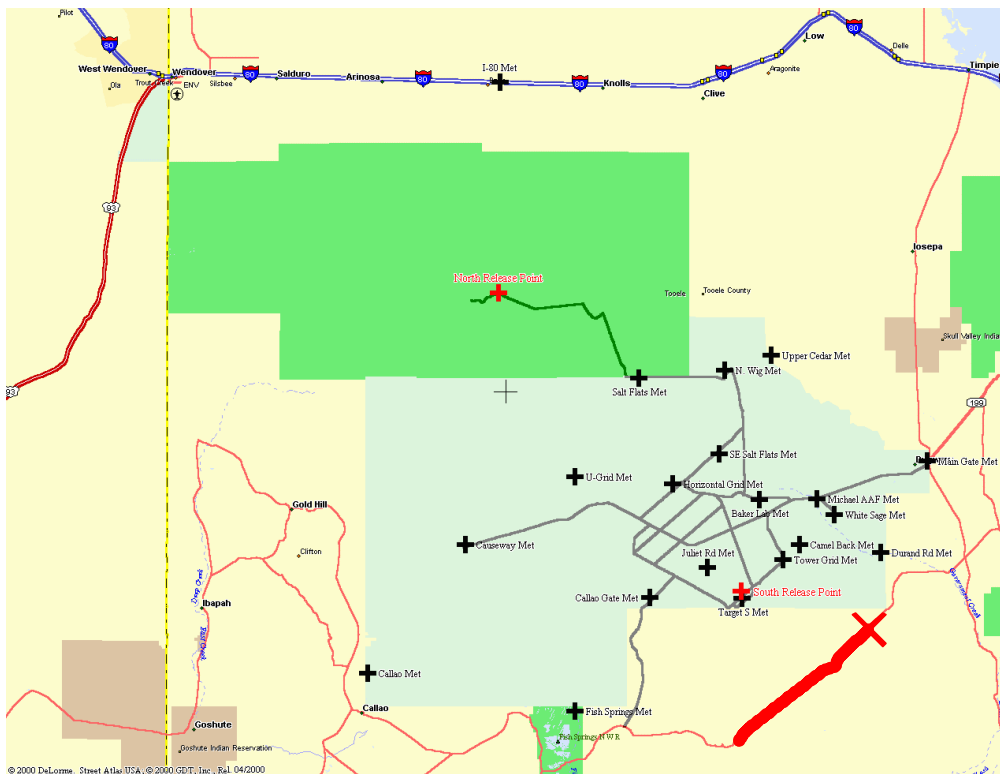
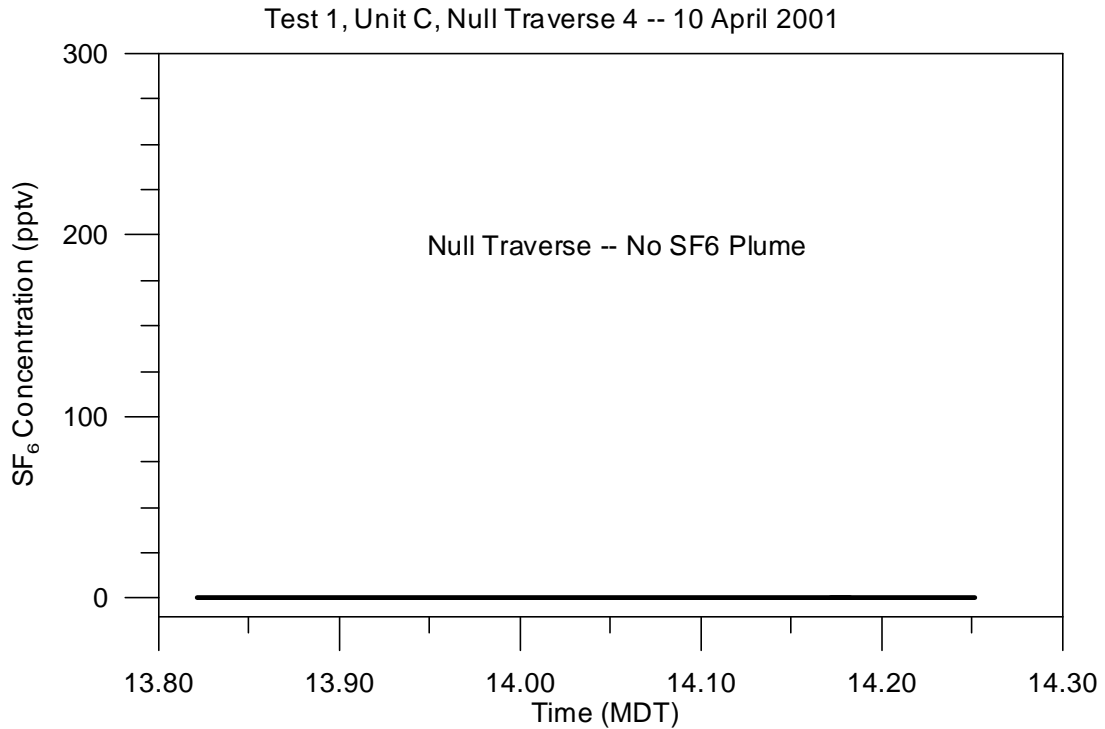


Figure A-30. Null sampling traverse 4 made by Sampling Unit C during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

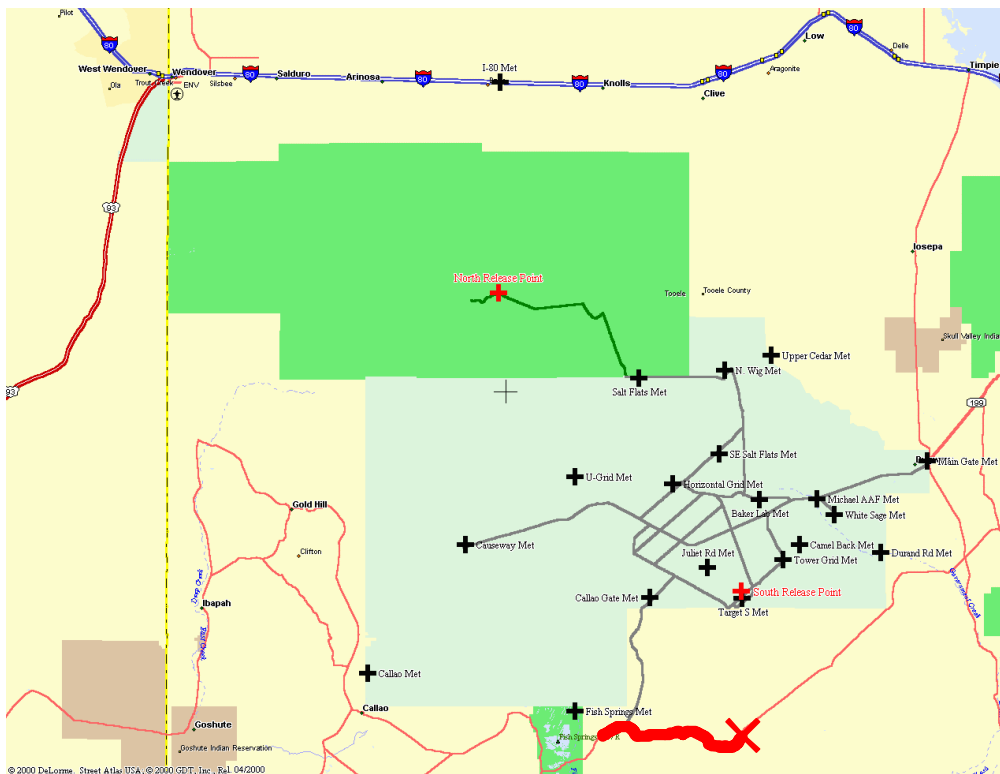
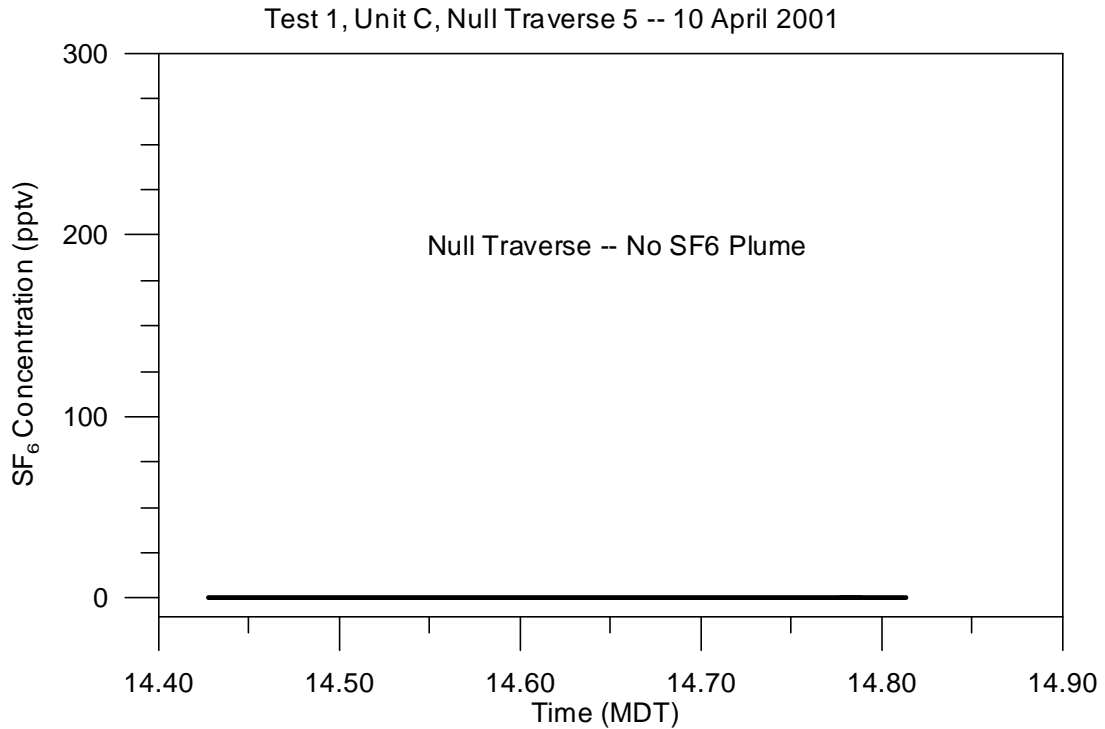


Figure A-31. Null sampling traverse 5 made by Sampling Unit C during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

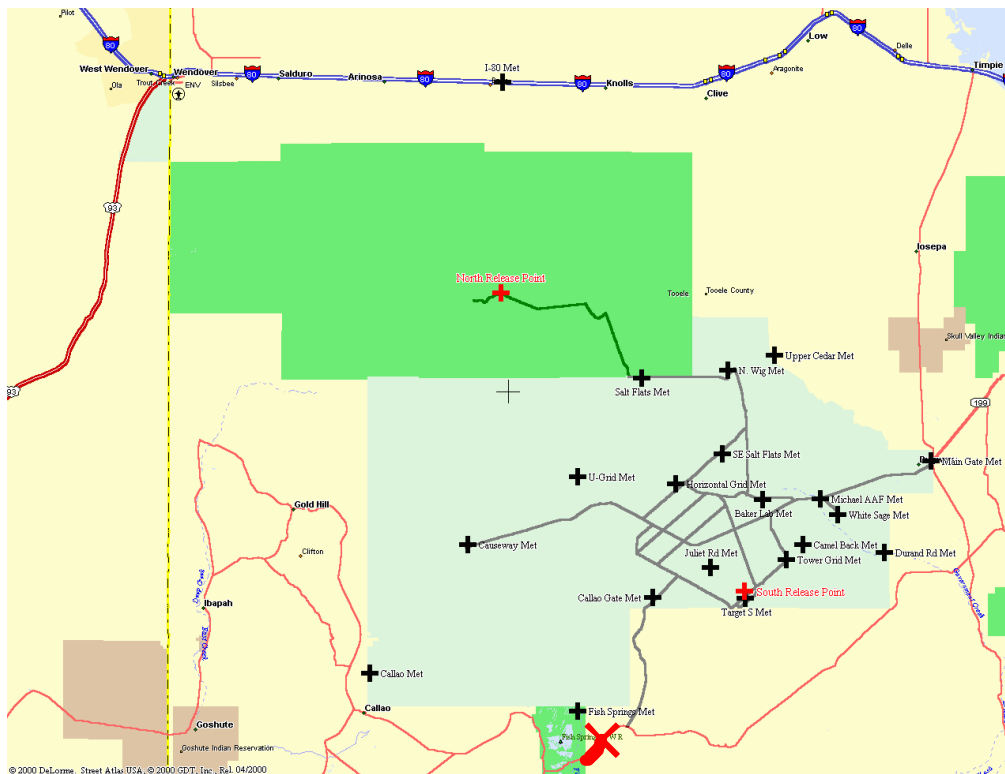
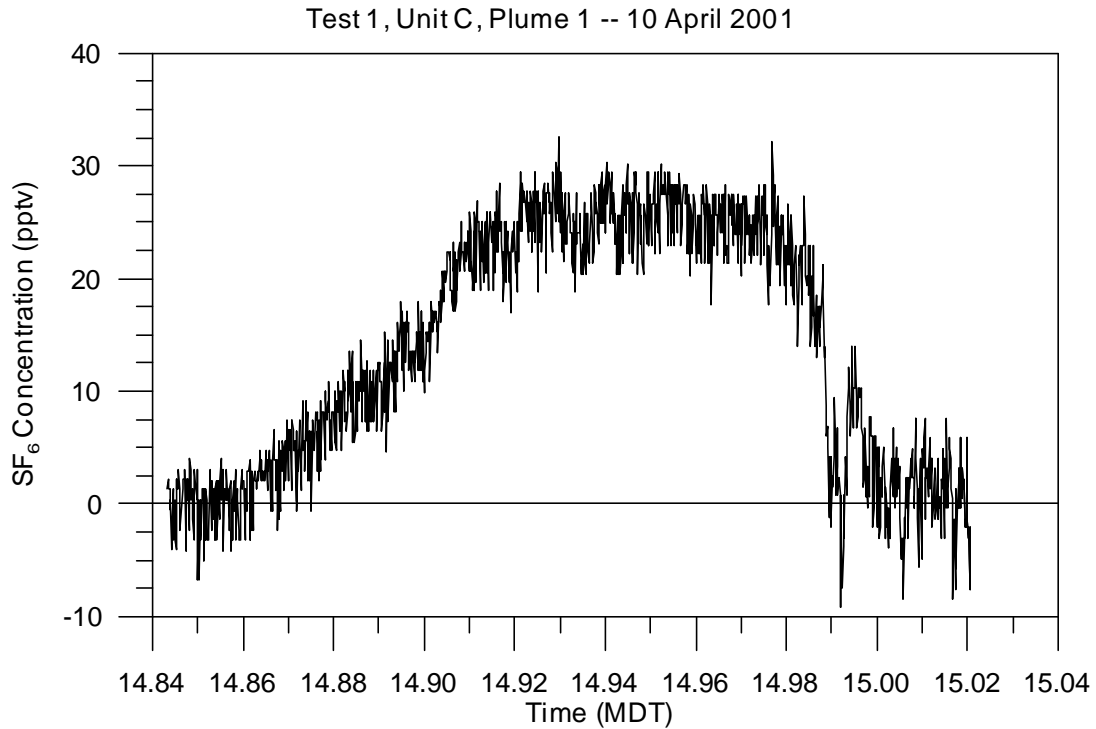


Figure A-32. SF₆ concentration of Plume 1 for Sampling Unit C during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

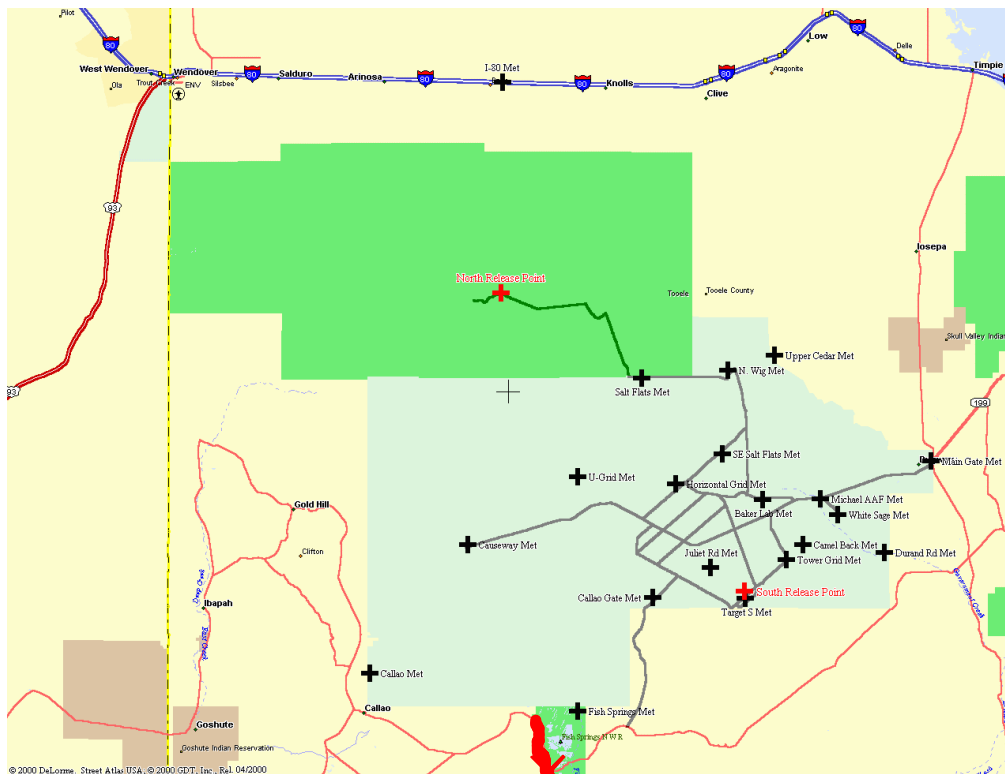
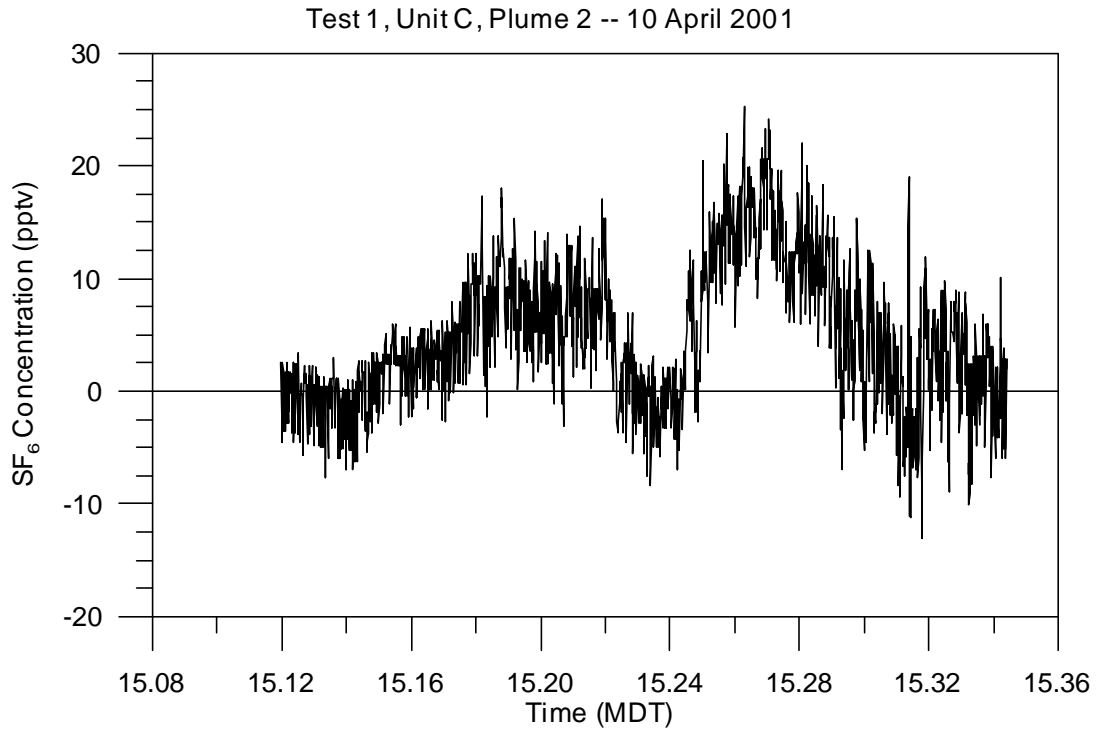


Figure A-33. SF₆ concentration of Plume 2 for Sampling Unit C during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

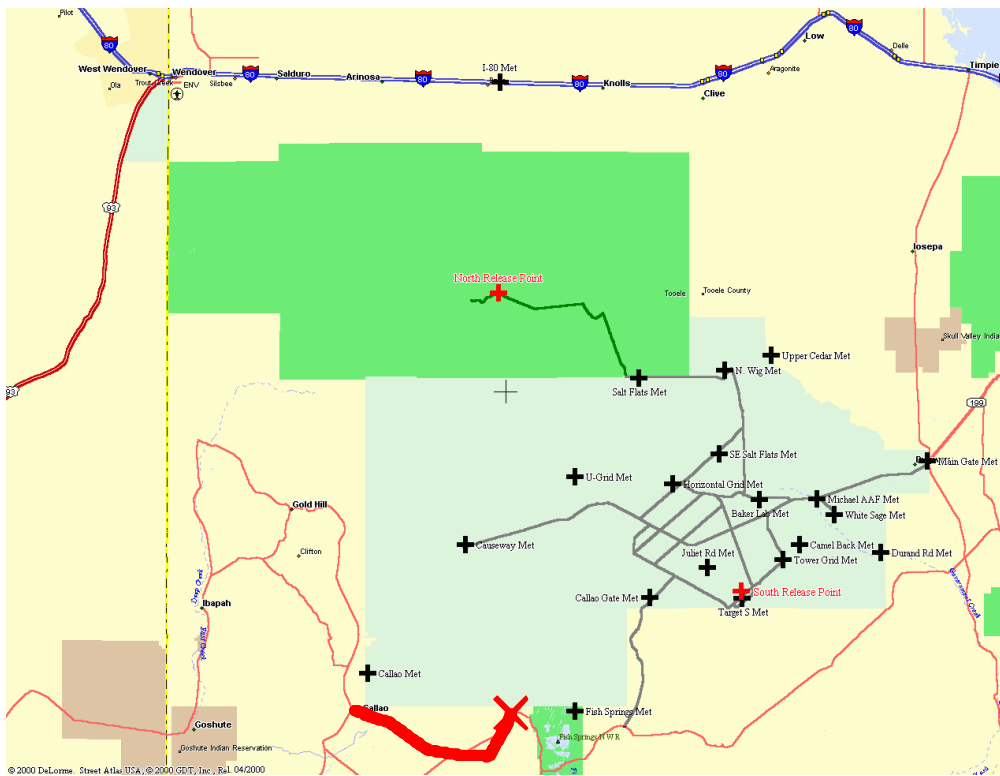
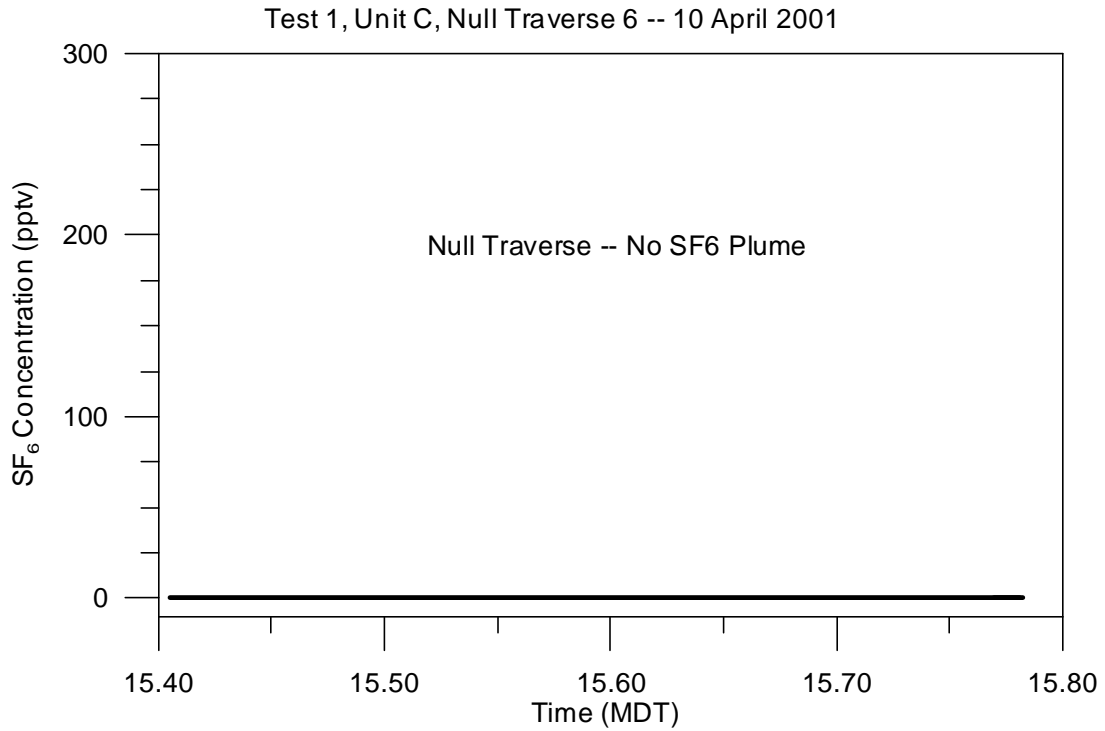


Figure A-34. Null sampling traverse 6 made by Sampling Unit C during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

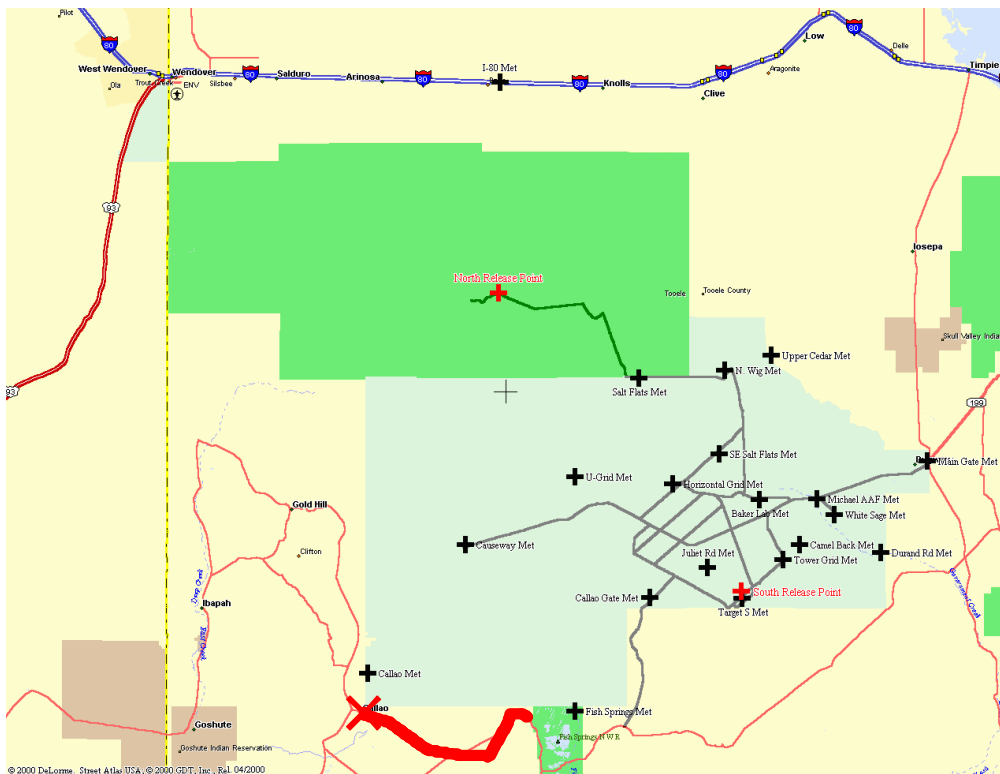
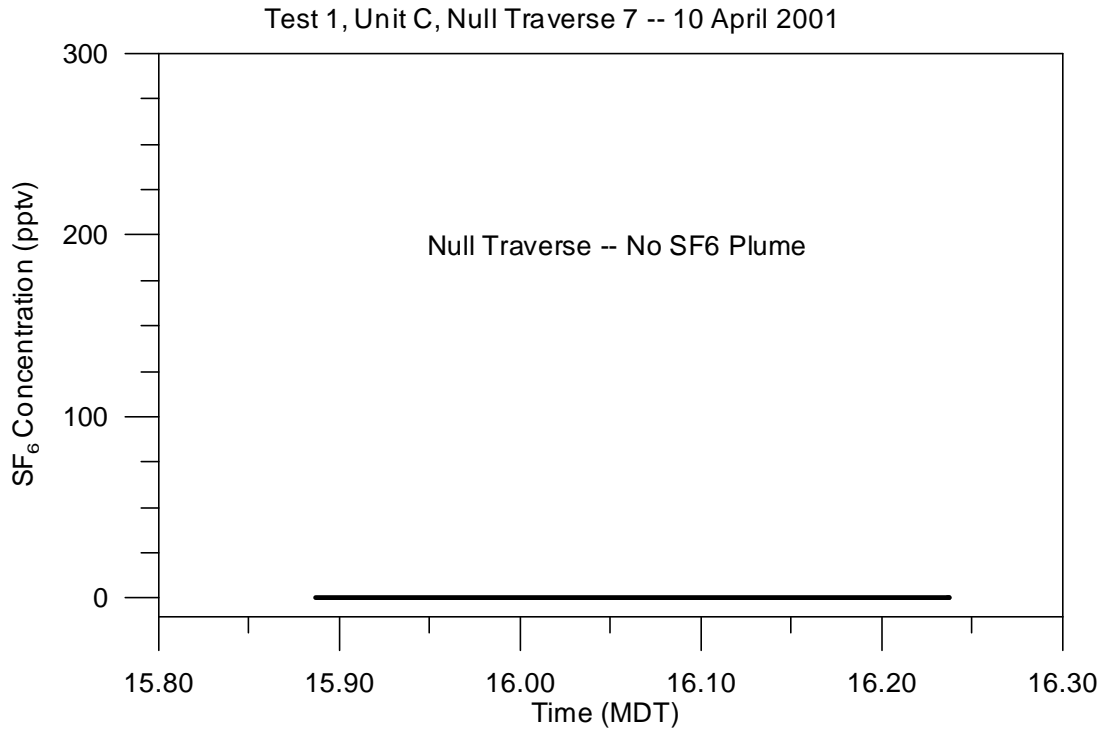


Figure A-35. Null sampling traverse 7 made by Sampling Unit C during Test 1, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

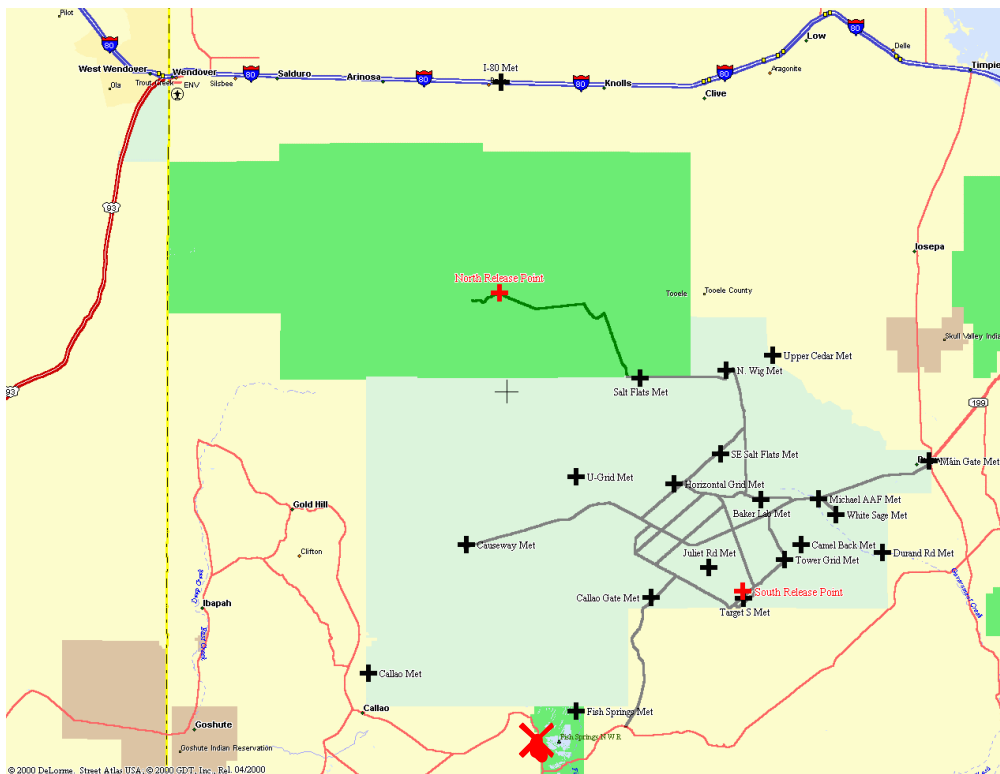
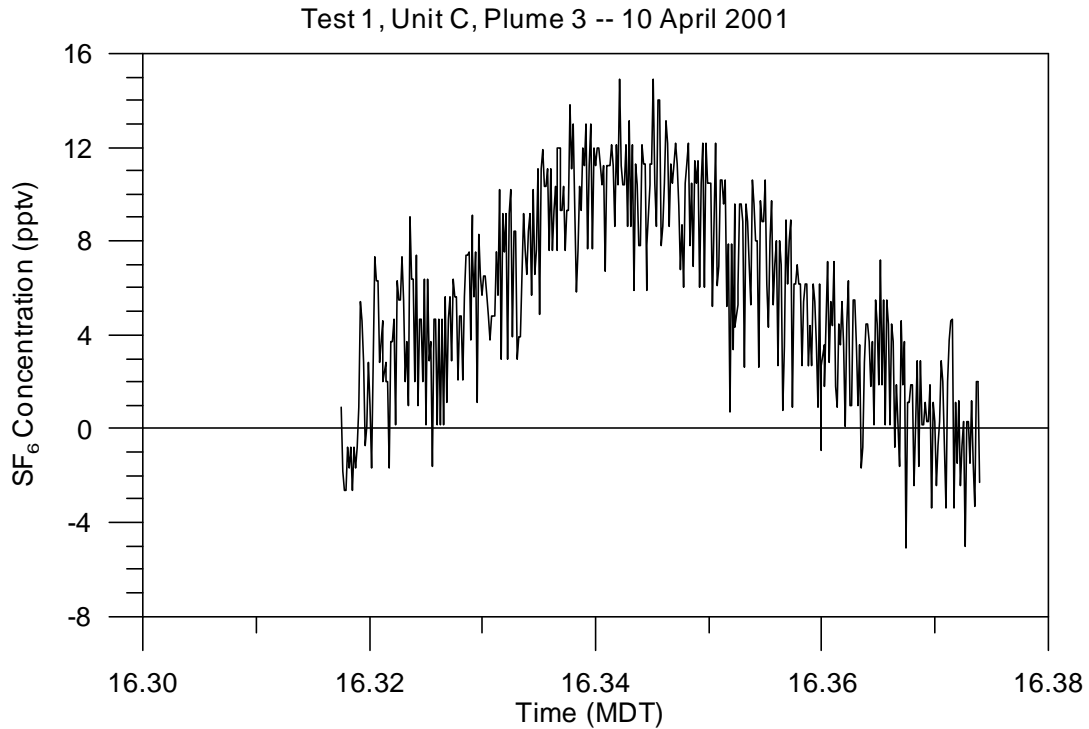


Figure A-36. SF₆ concentration of Plume 3 for Sampling Unit C during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

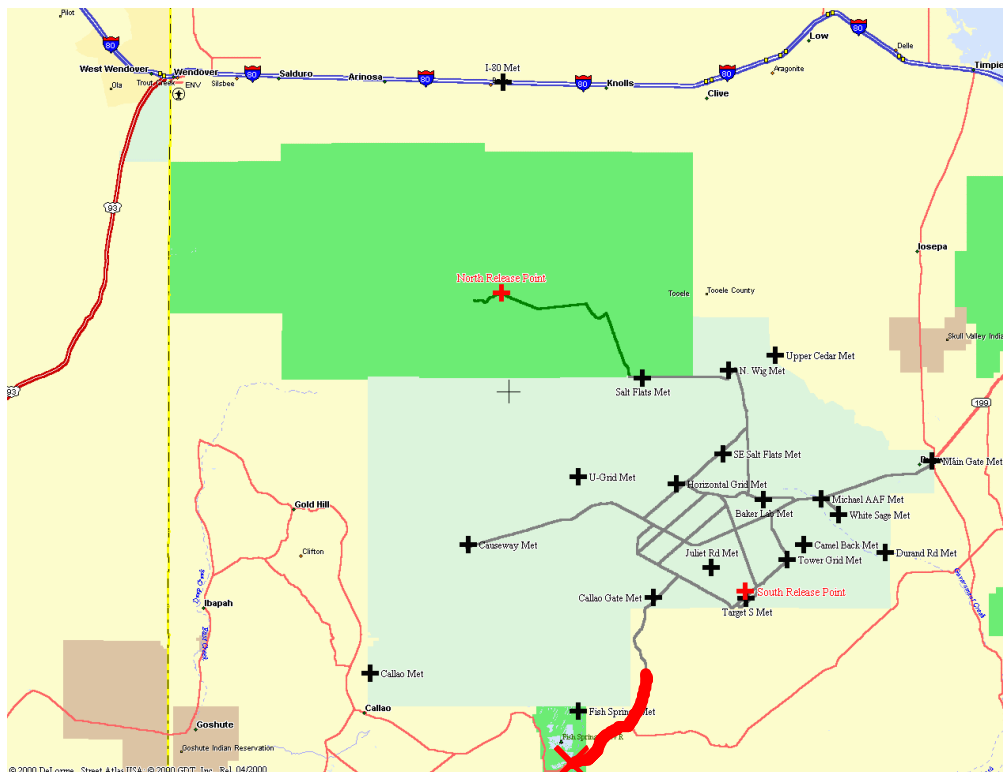
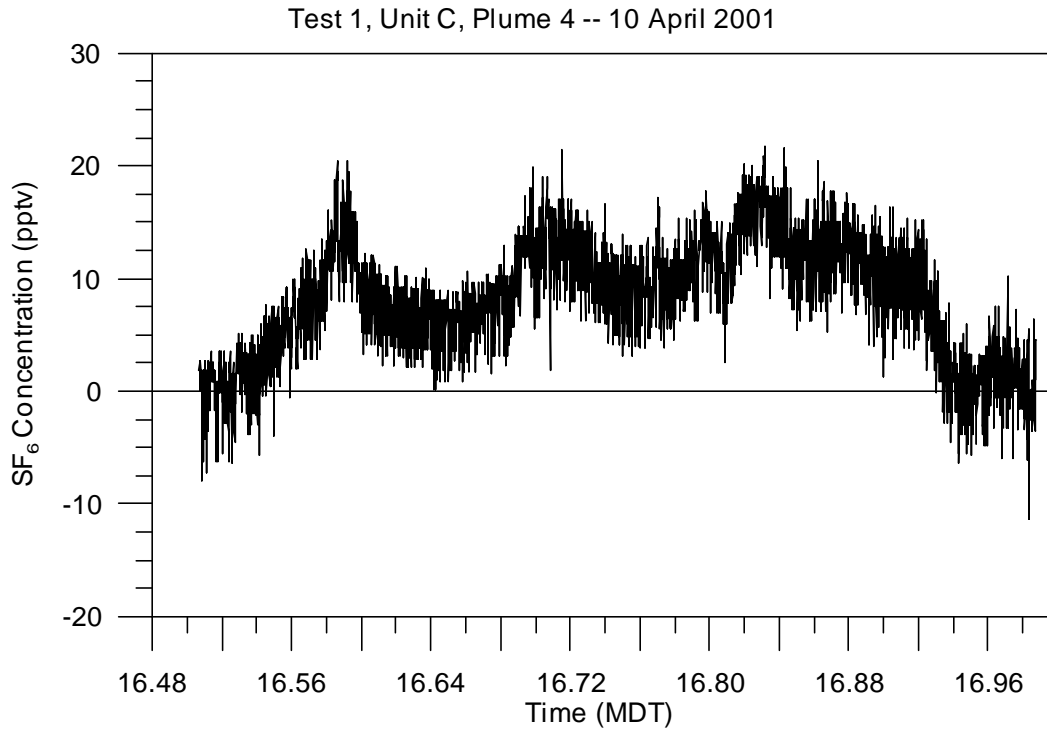


Figure A-37. SF₆ concentration of Plume 4 for Sampling Unit C during Test 1 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 2 Sampling Unit A

Table A-15. Test 2 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	12:21	12:26
2	12:33	12:46
3	12:55	13:09
4	13:13	13:24
5	13:42	13:54

Table A-16. Summary of individual SF₆ plume characteristics measured by Sampling Unit A during Test 2. Bearings and ranges are given to the North Release Point (TS-5).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	13:55-13:58	343	116.1-118.9	39.91	40.65	41.06
2	14:44-14:49	593	122.7-129.7	39.21	39.75	40.34
3	14:49-14:51	245	119.6-121.9	40.52	40.68	40.85
4	14:52-14:56	466	116.4-119.0	40.07	40.51	41.05
5	15:19-15:22	301	116.7-119.2	40.21	40.77	41.05
6	15:25-15:33	966	121.4-132.4	38.93	39.73	40.59
7	15:56-16:06	1251	116.8-124.7	39.94	40.59	41.05
8	16:20-16:29	1058	121.6-130.1	39.16	39.80	40.57
9	16:39-16:48	1072	122.1-133.3	38.86	39.57	40.49

Table A-17. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the North Release Point (TS-5) of each individual plume traverse measured by Sampling Unit A during Test 2.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	14.9	13:57	40.281397	113.048483	117.9	40.69
2	19.5	14:45	40.238467	113.099568	126.9	39.58
3	24.4	14:51	40.266260	113.059220	120.5	40.71
4	19.8	14:54	40.285590	113.048658	117.3	40.46
5	20.1	15:21	40.275798	113.048465	118.6	40.98
6	27.6	15:29	40.237685	113.100762	127.1	39.55
7	21.4	16:04	40.280763	113.048498	117.9	40.72
8	24.6	16:25	40.241390	113.094990	126.2	39.69
9	19.7	16:47	40.254428	113.075100	123.1	40.26

Table A-18. Test 2 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) during active SF₆ plume encounters.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
6	14:06	14:24

Table A-19. Test 2 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) after active SF₆ plume encounters.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
7	16:57	17:09
8	17:13	17:26
9	17:29	17:44

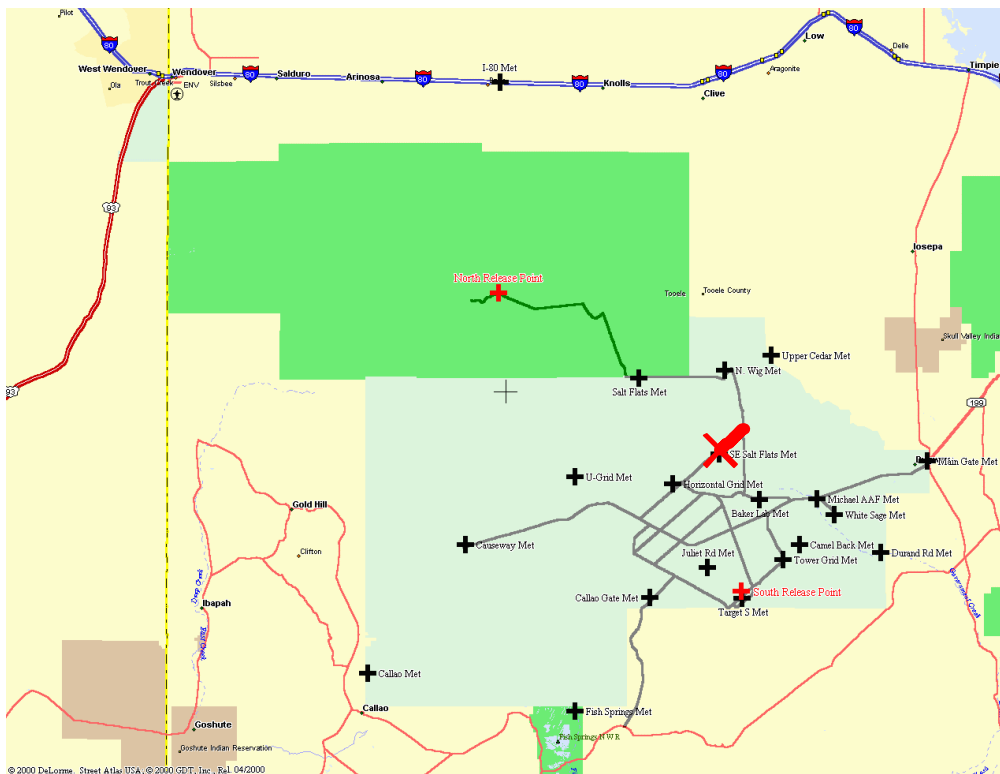
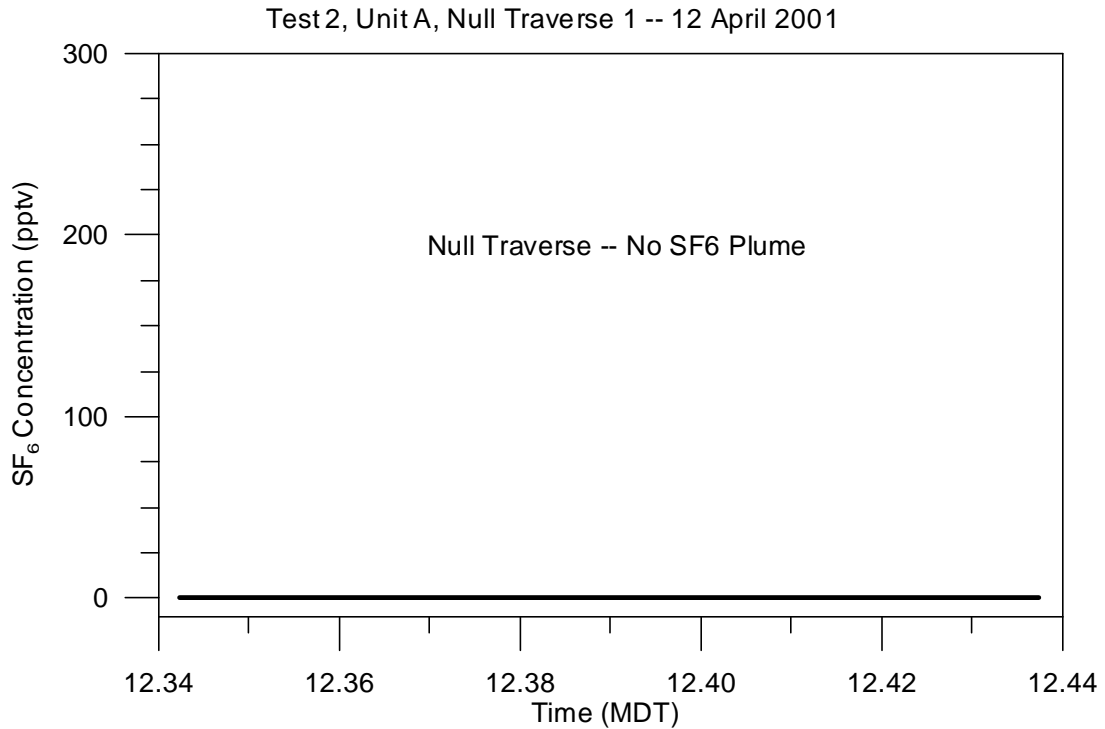


Figure A-38. Null sampling traverse 1 made by Sampling Unit A during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

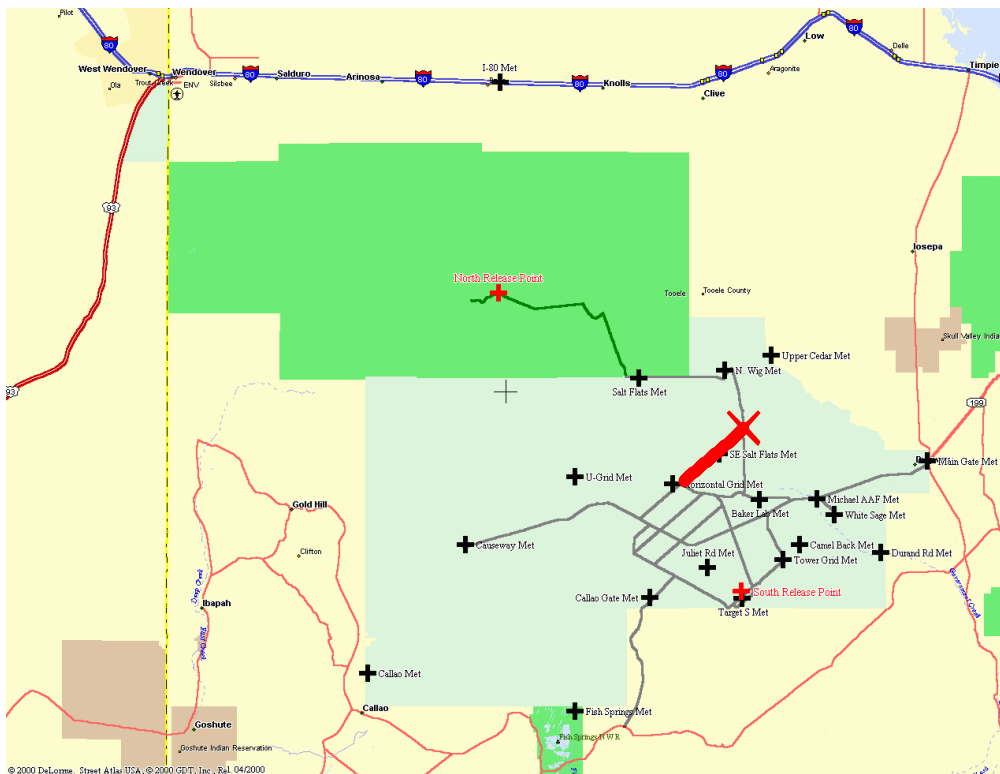
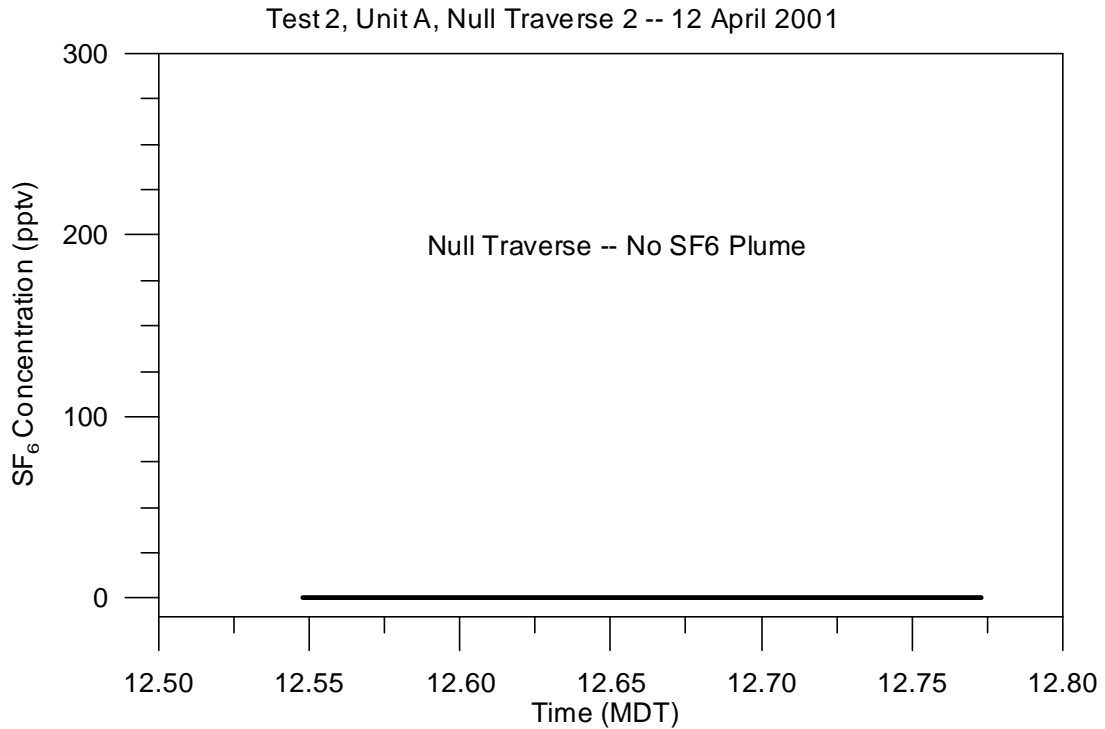


Figure A-39. Null sampling traverse 2 made by Sampling Unit A during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

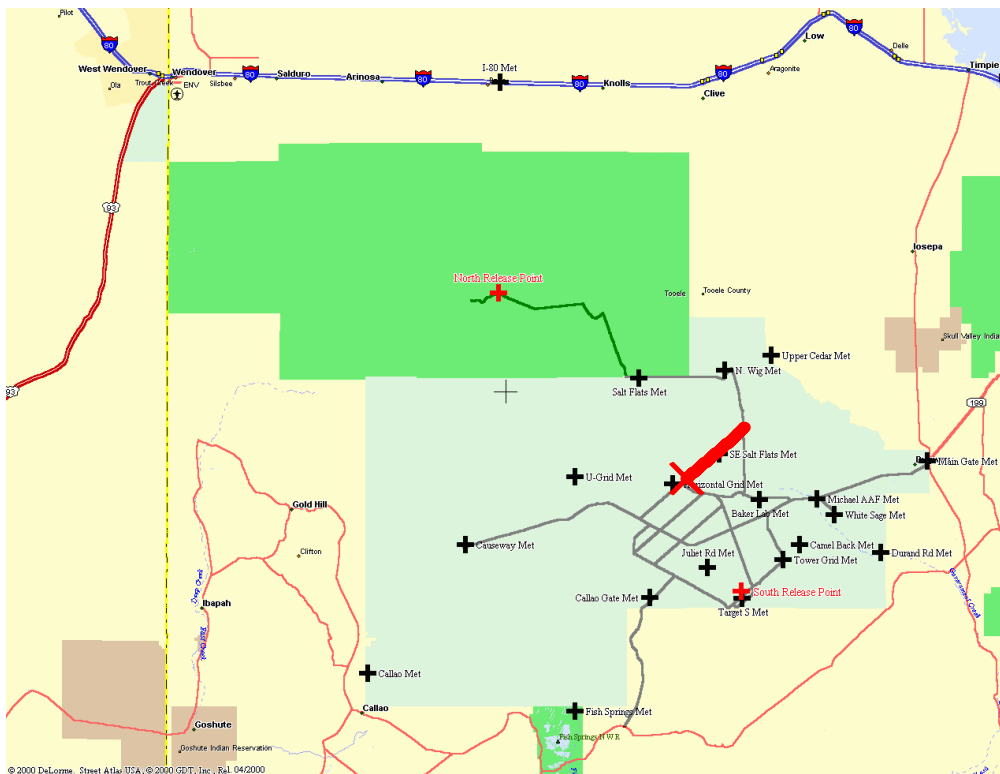
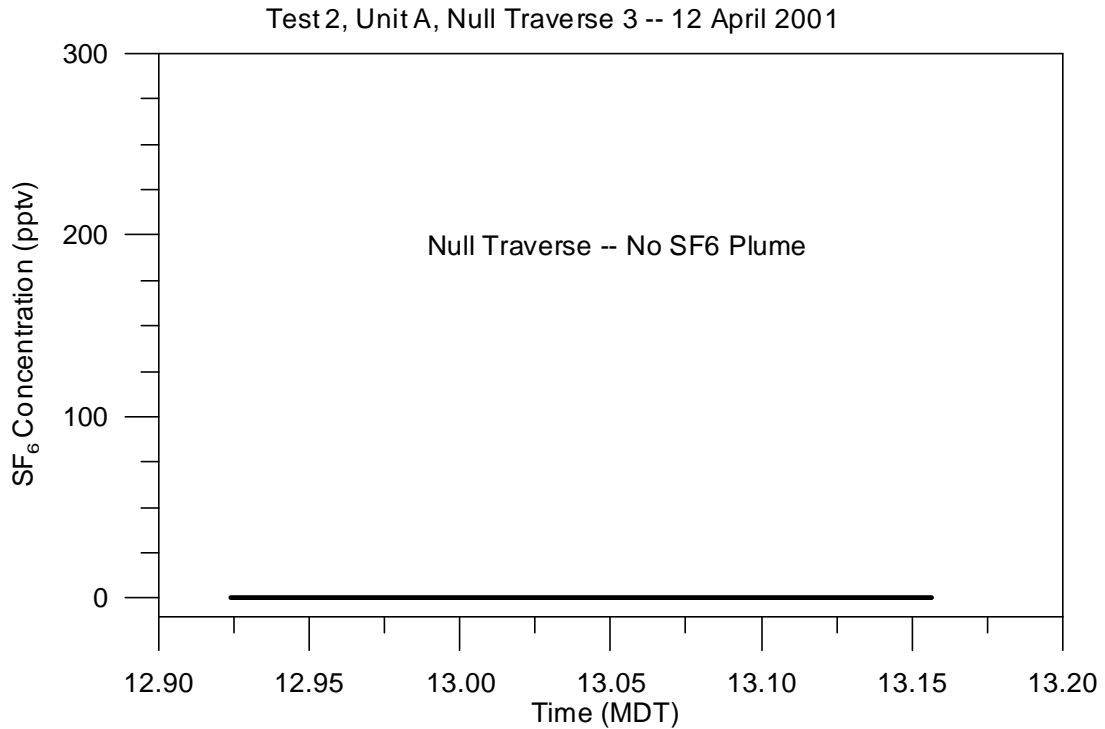


Figure A-40. Null sampling traverse 3 made by Sampling Unit A during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

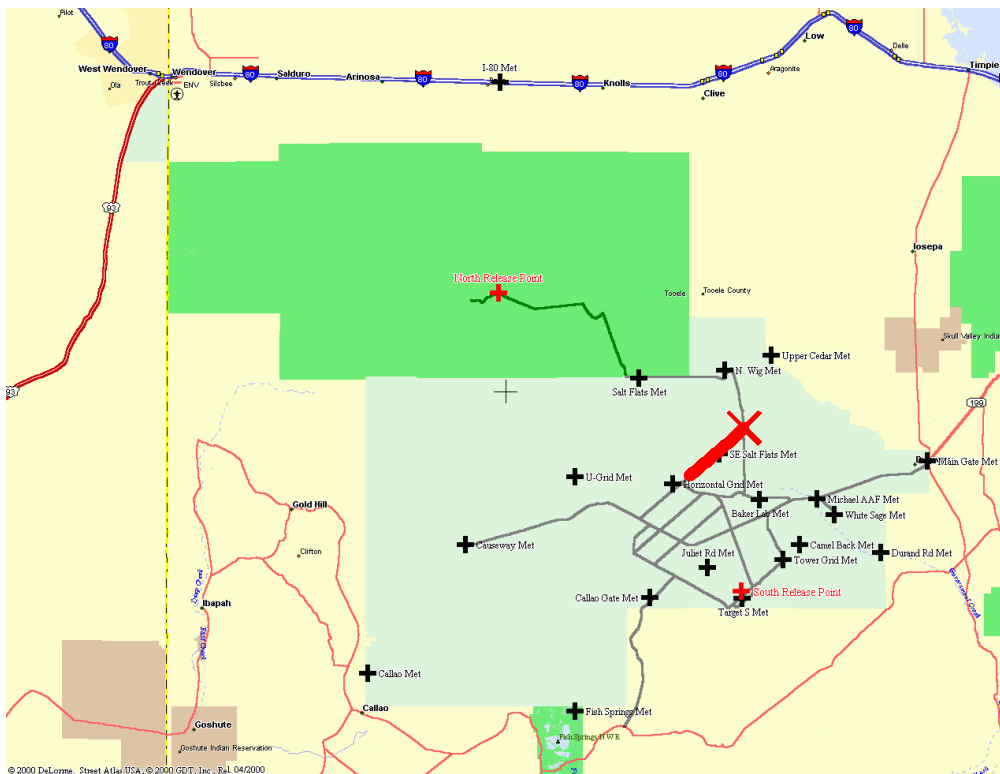
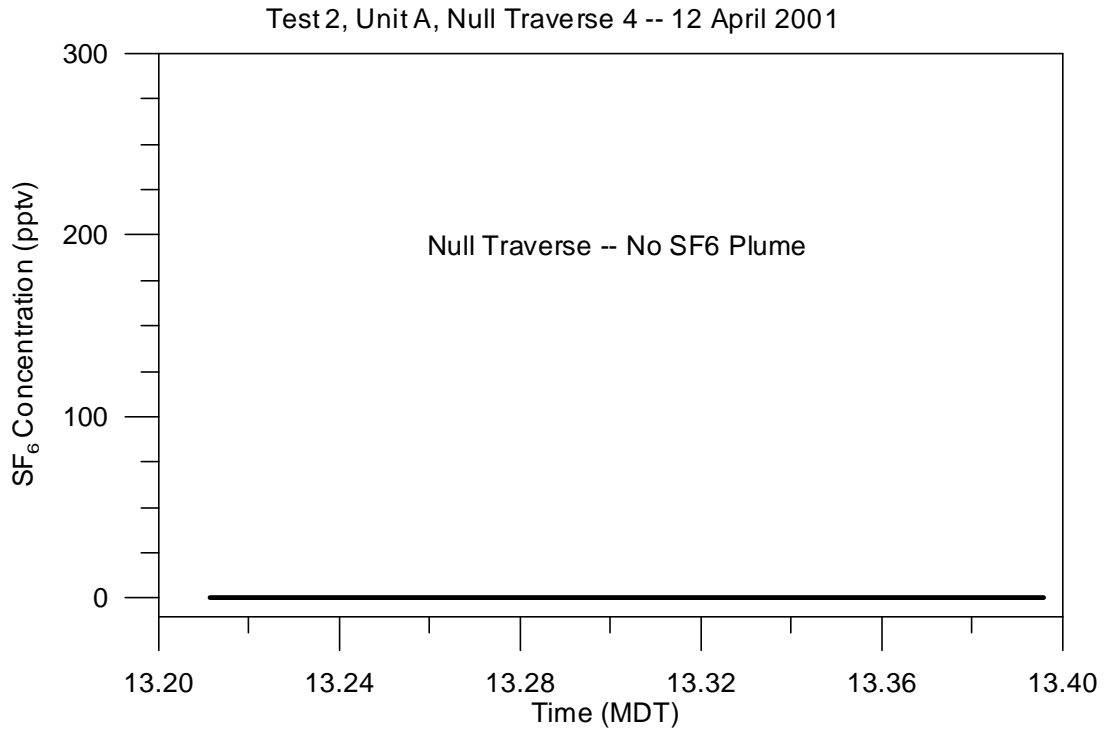


Figure A-41. Null sampling traverse 4 made by Sampling Unit A during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

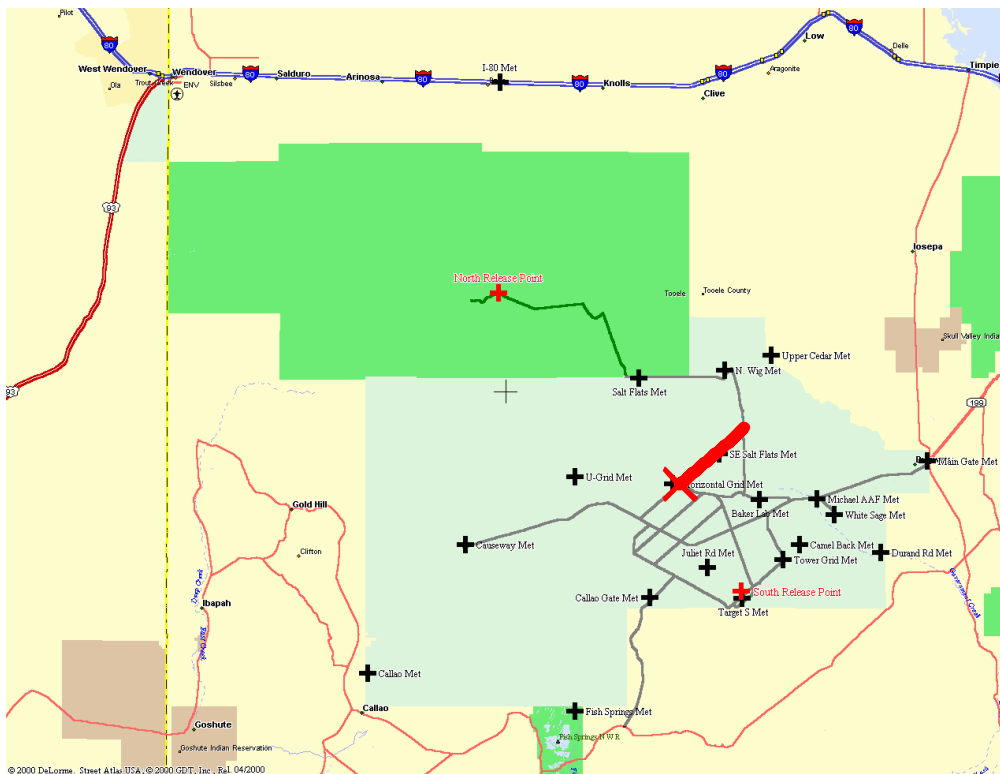
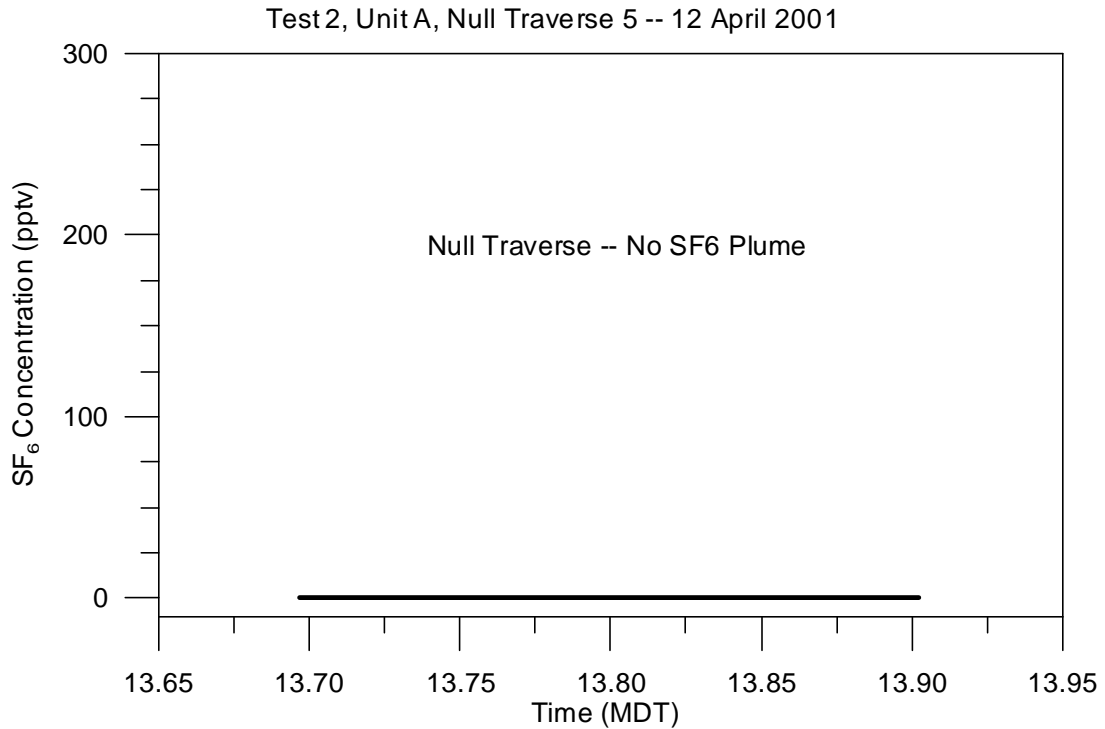


Figure A-42. Null sampling traverse 5 made by Sampling Unit A during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

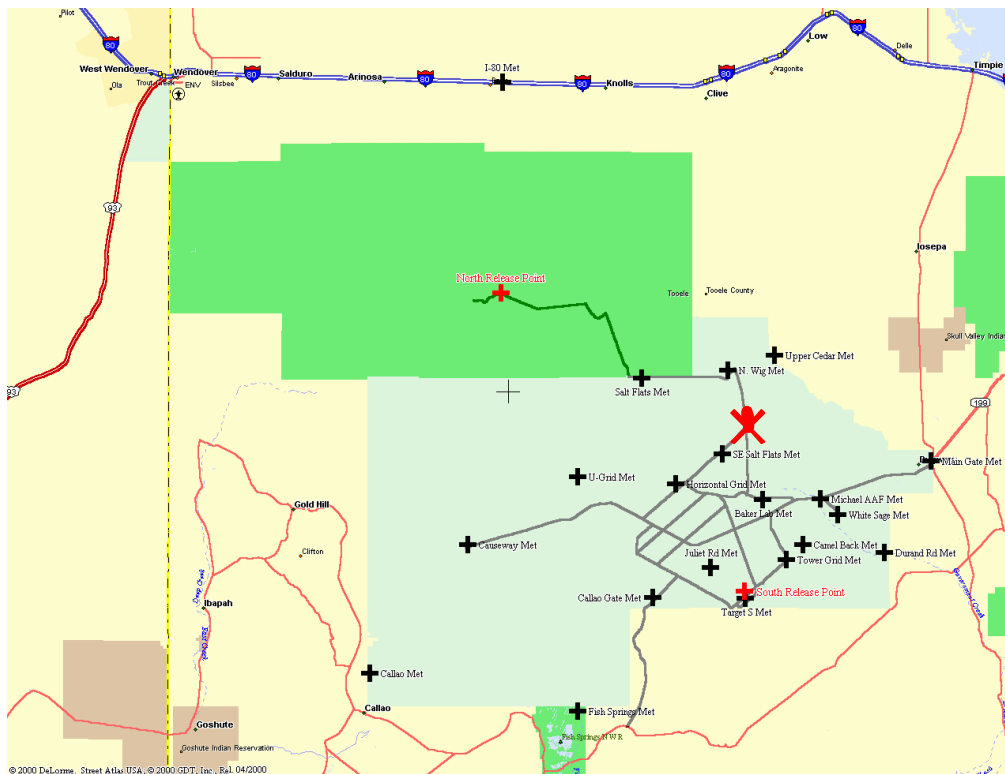
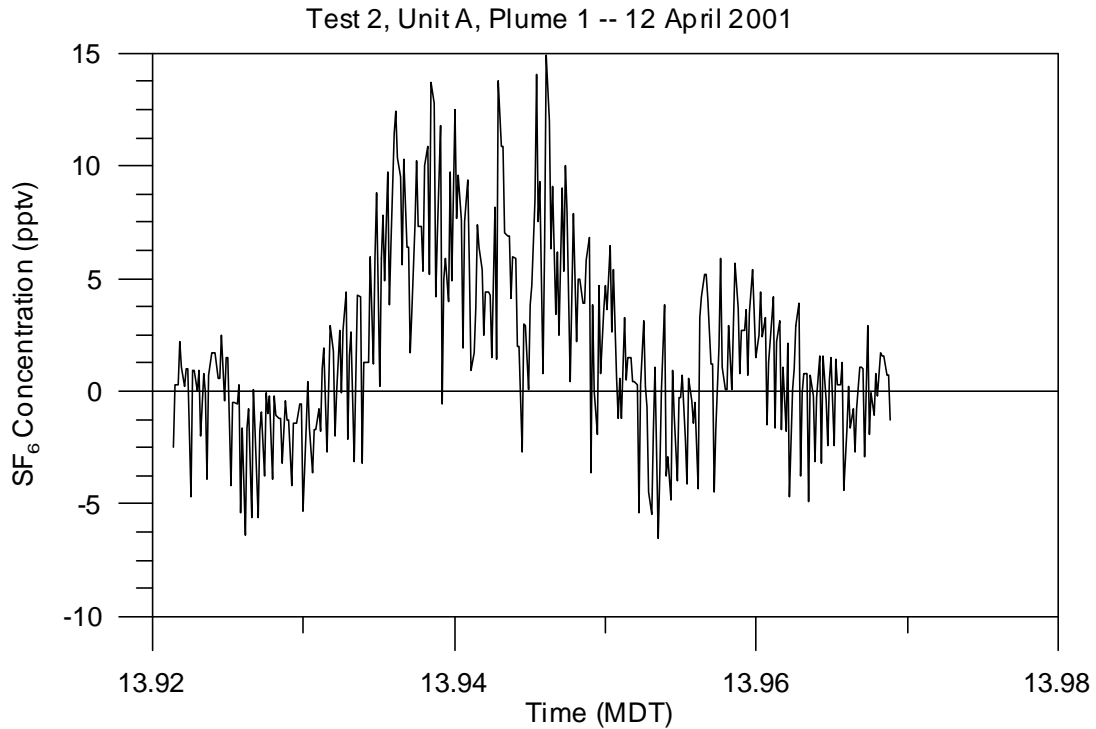


Figure A-43. SF₆ concentration of Plume 1 for Sampling Unit A during Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

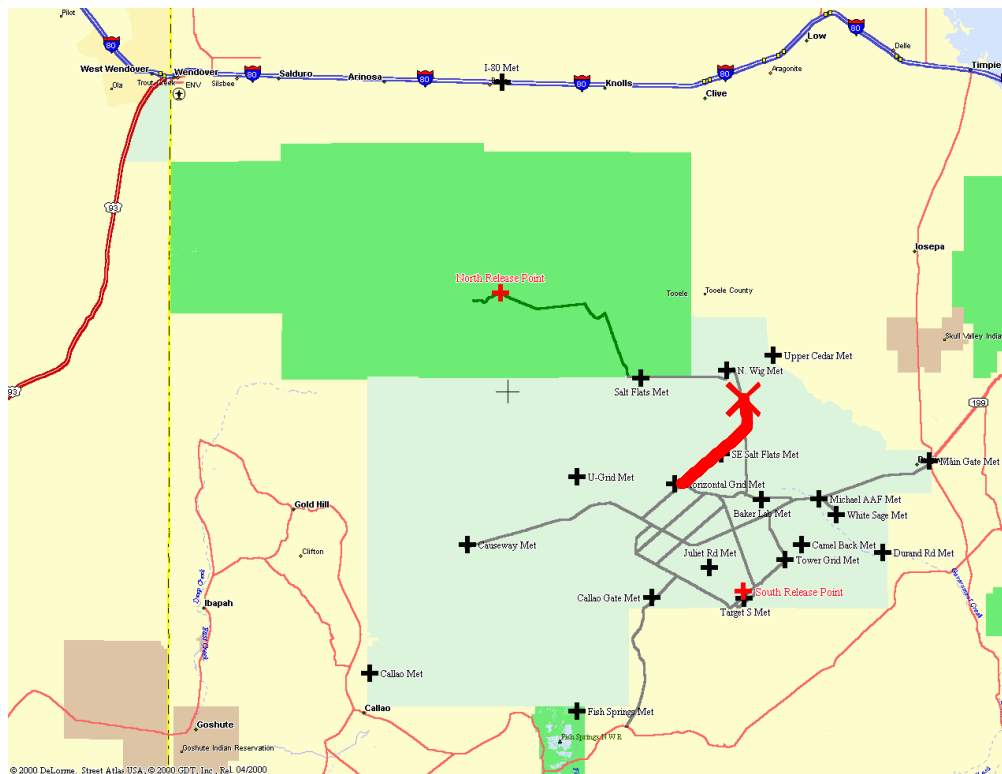
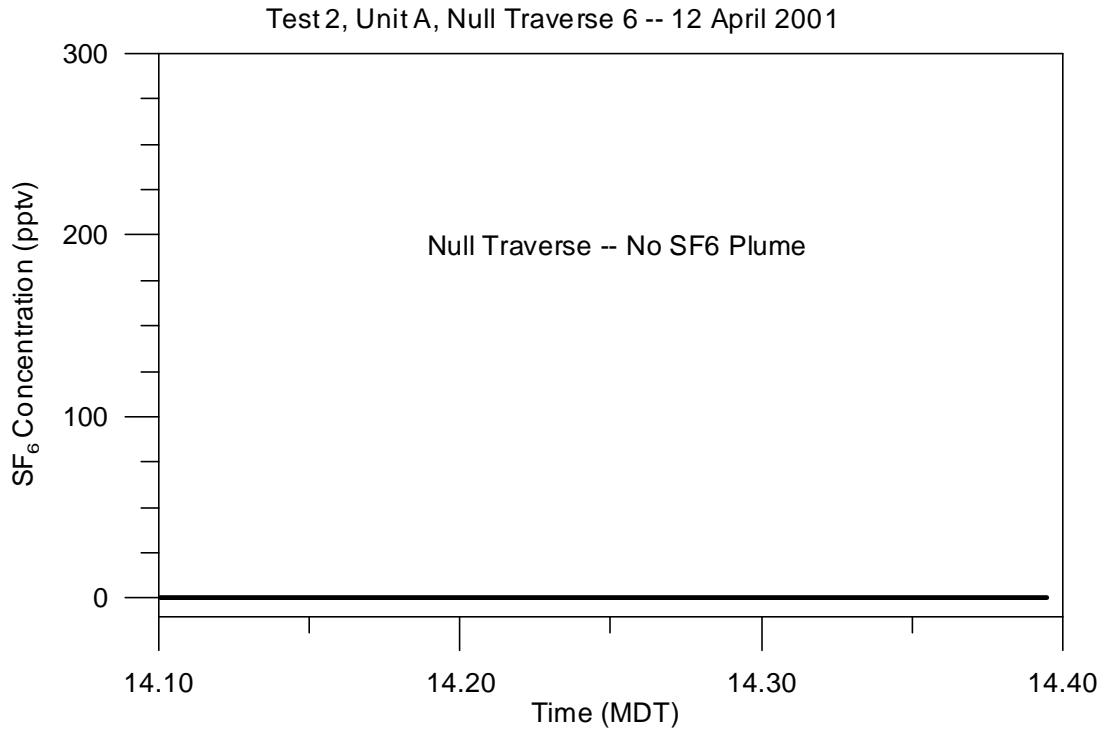


Figure A-44. Null sampling traverse 6 made by Sampling Unit A during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

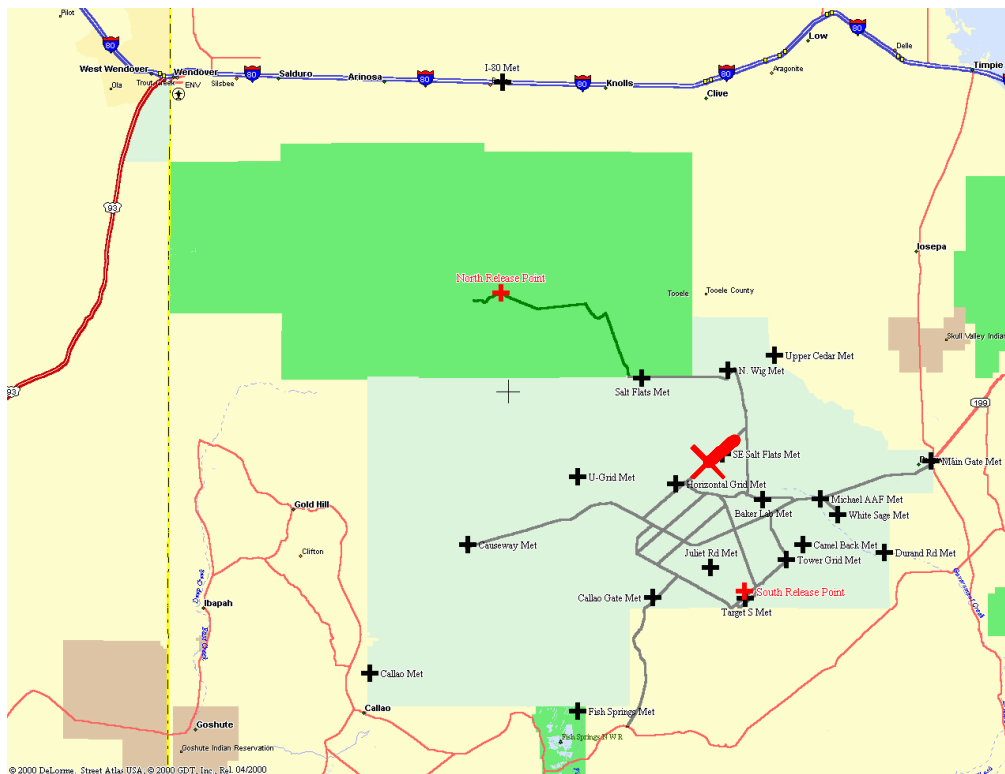
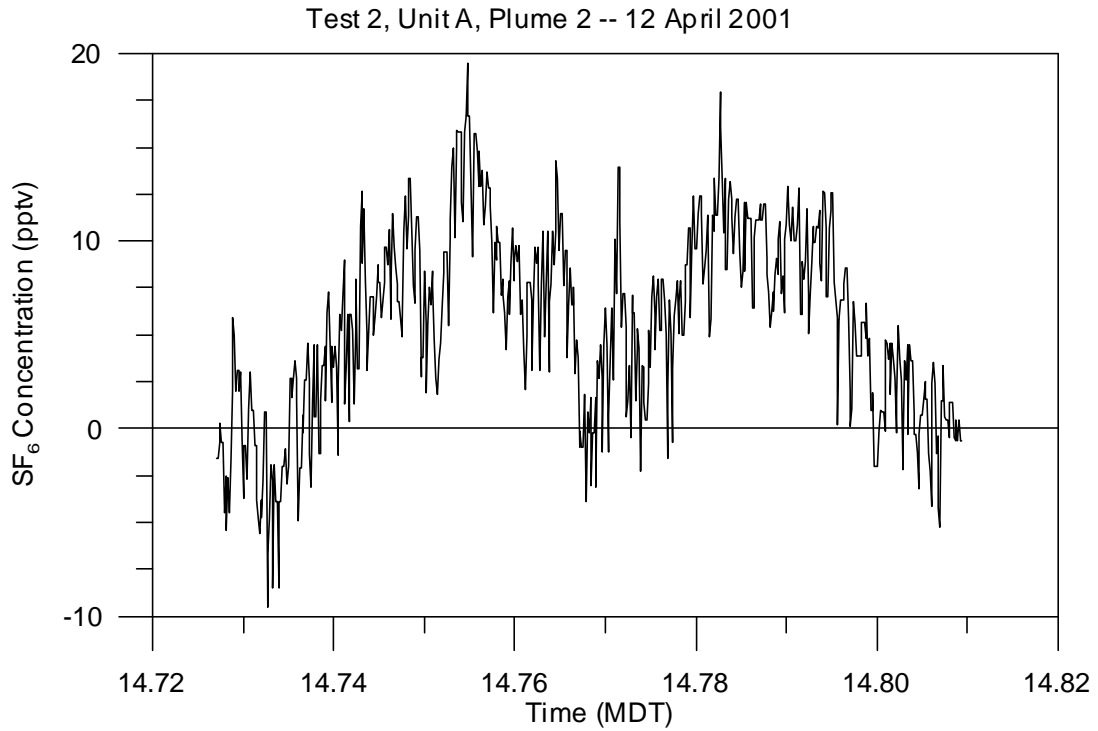


Figure A-45. SF₆ concentration of Plume 2 for Sampling Unit A during Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

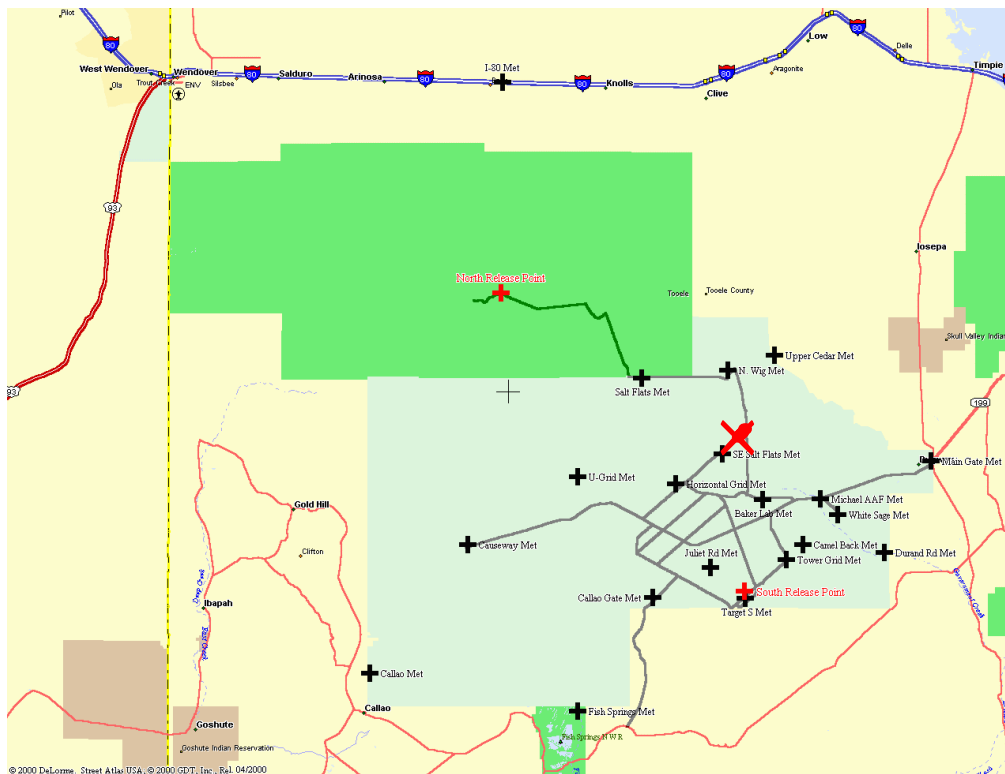
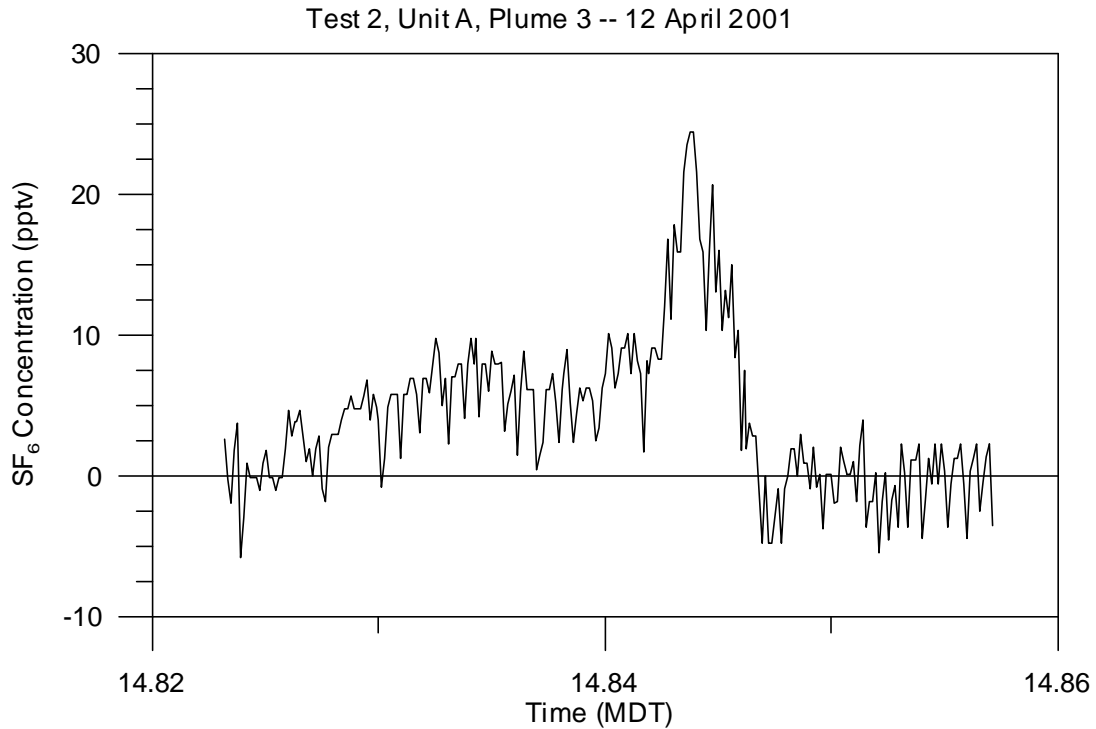


Figure A-46. SF₆ concentration of Plume 3 for Sampling Unit A during Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

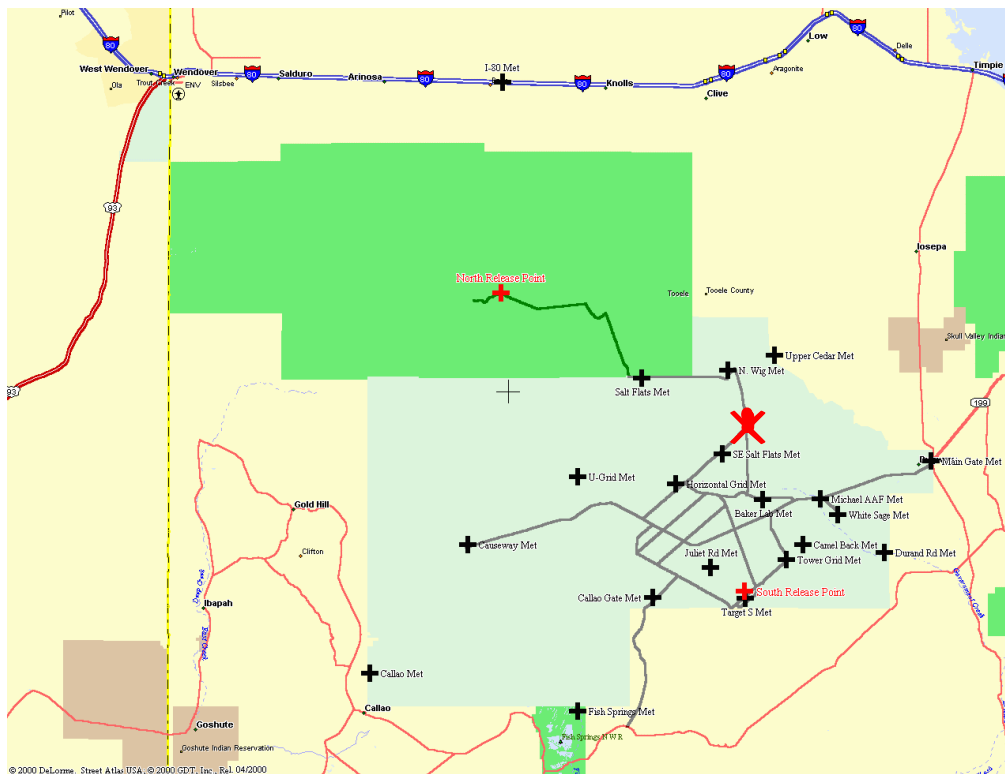
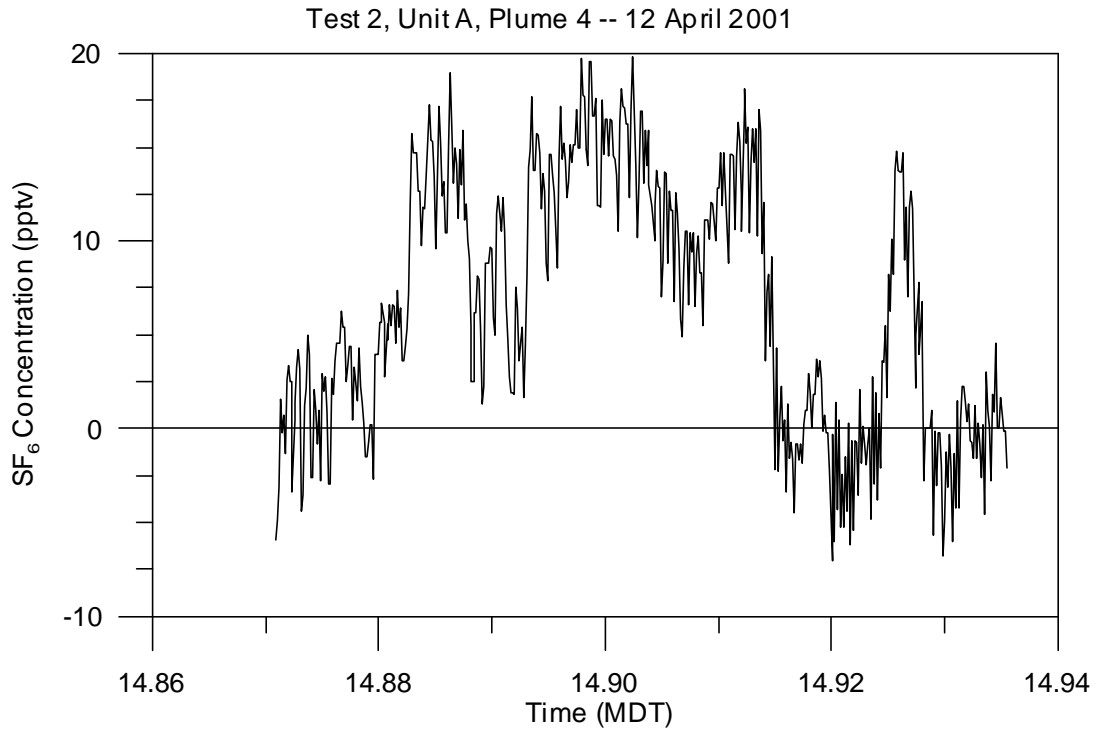


Figure A-47. SF₆ concentration of Plume 4 for Sampling Unit A during Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

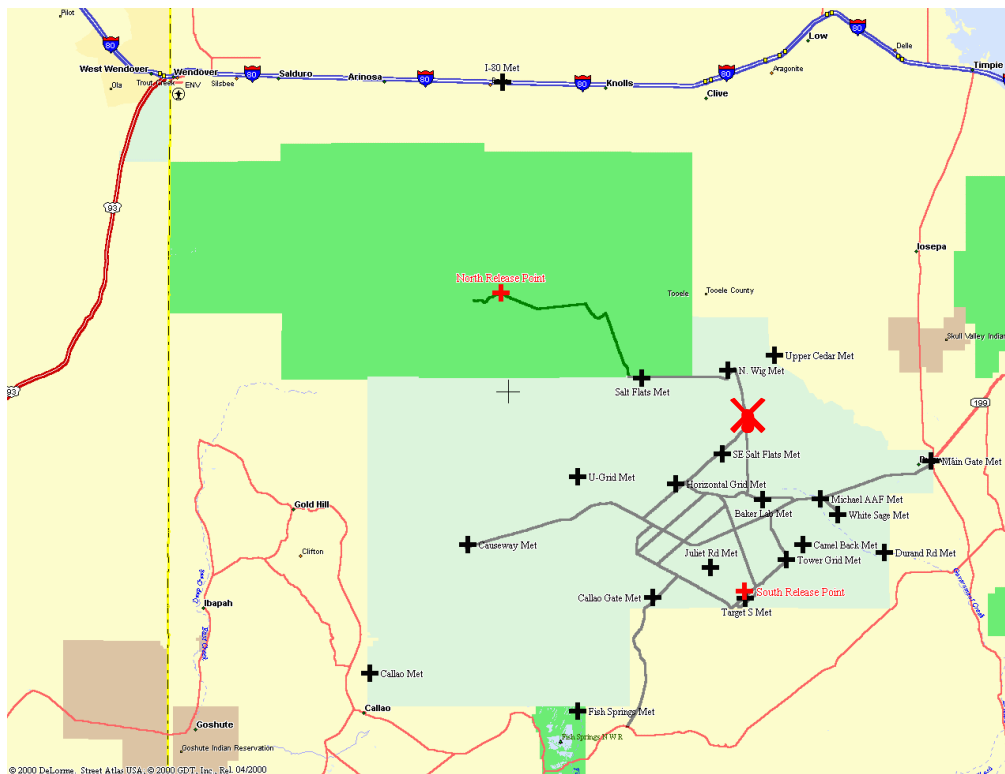
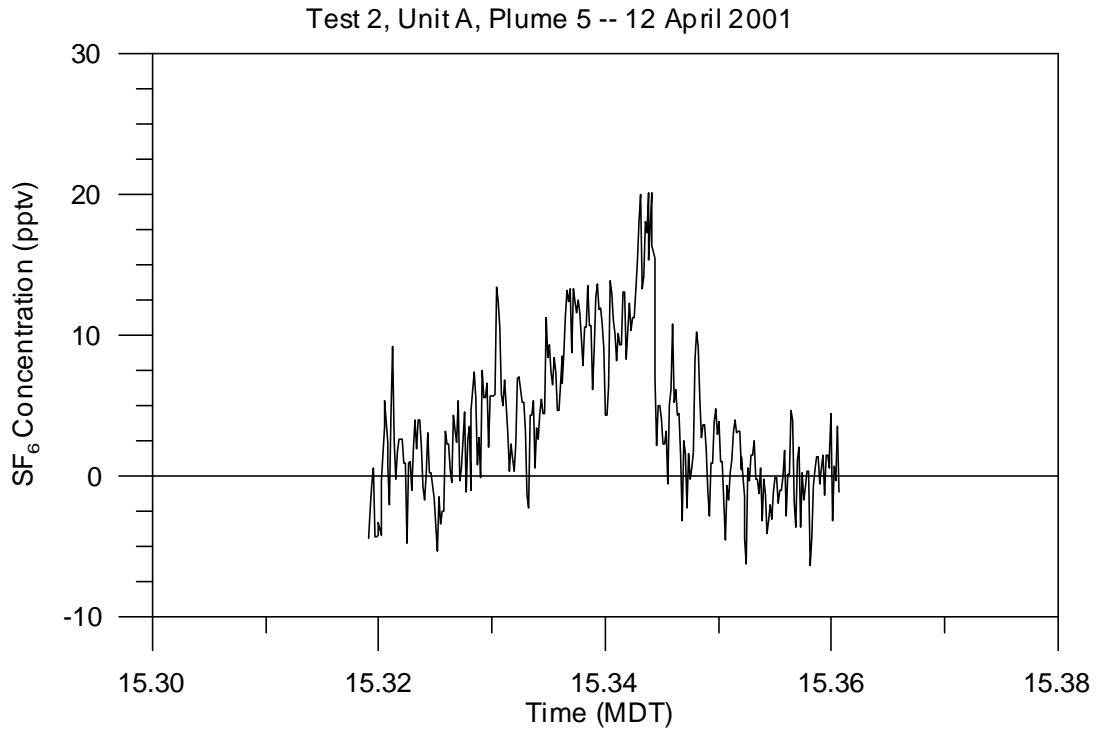


Figure A-48. SF₆ concentration of Plume 5 for Sampling Unit A during Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

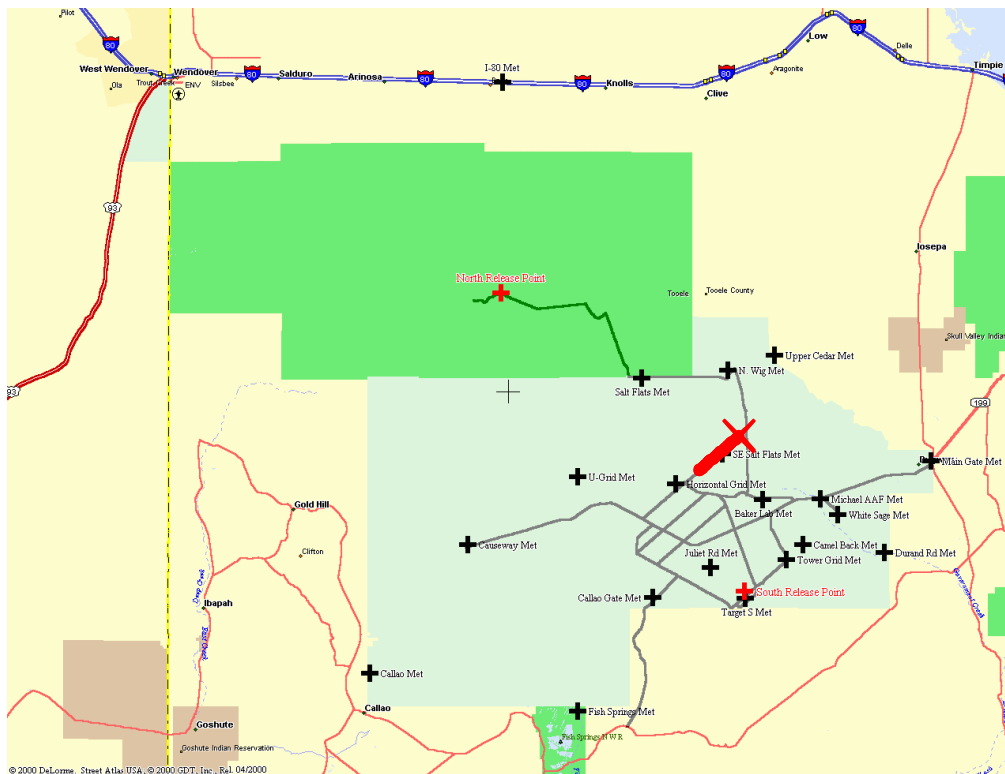
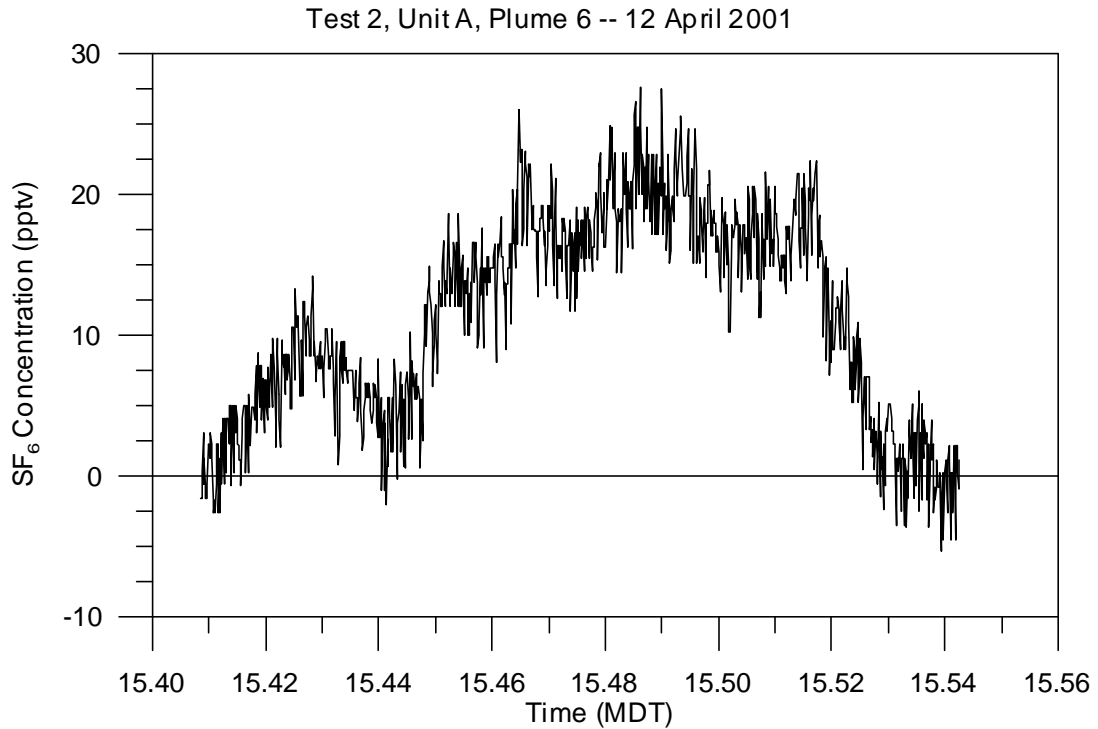


Figure A-49. SF₆ concentration of Plume 6 for Sampling Unit A during Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

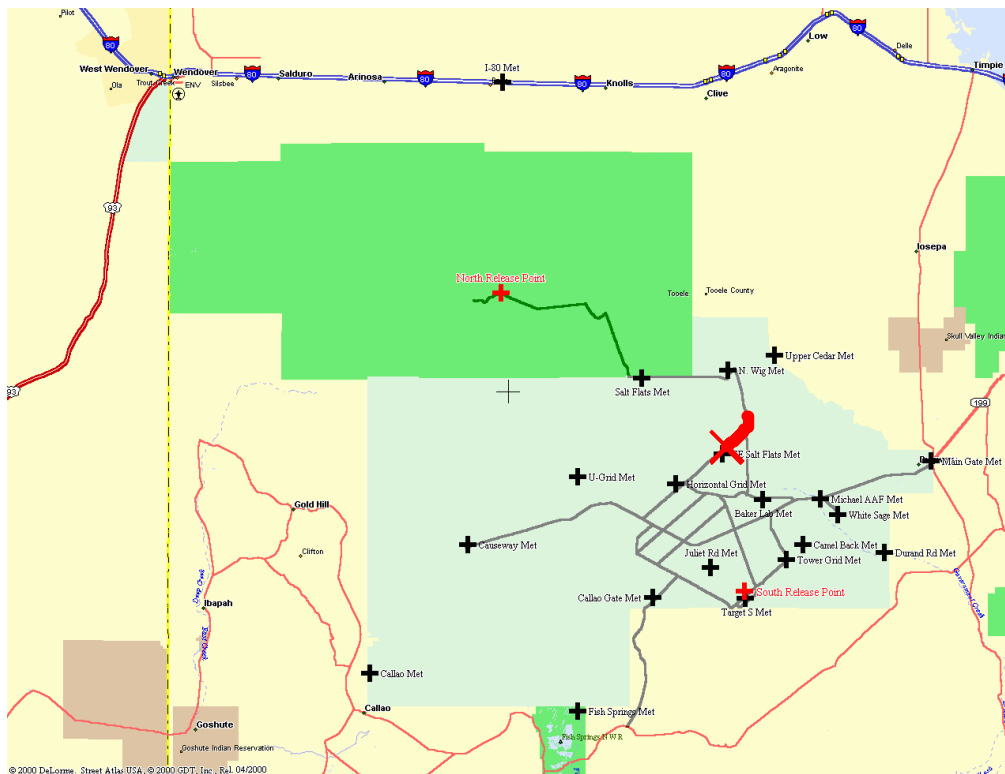
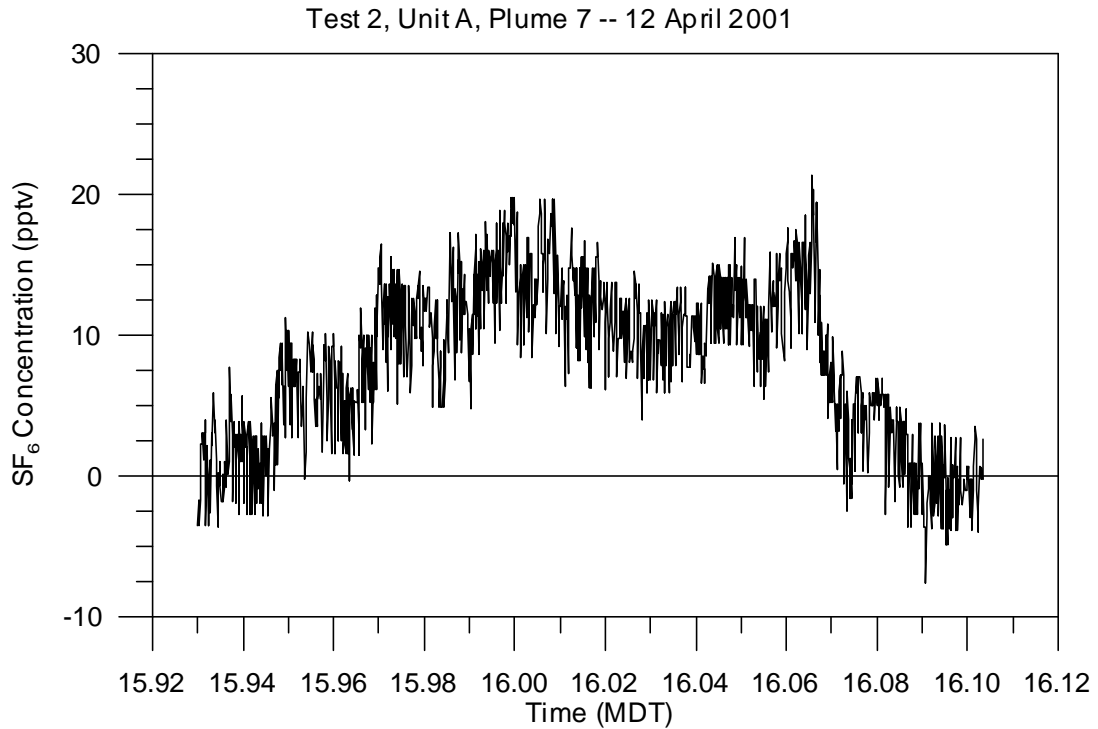


Figure A-50. SF₆ concentration of Plume 7 for Sampling Unit A during Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

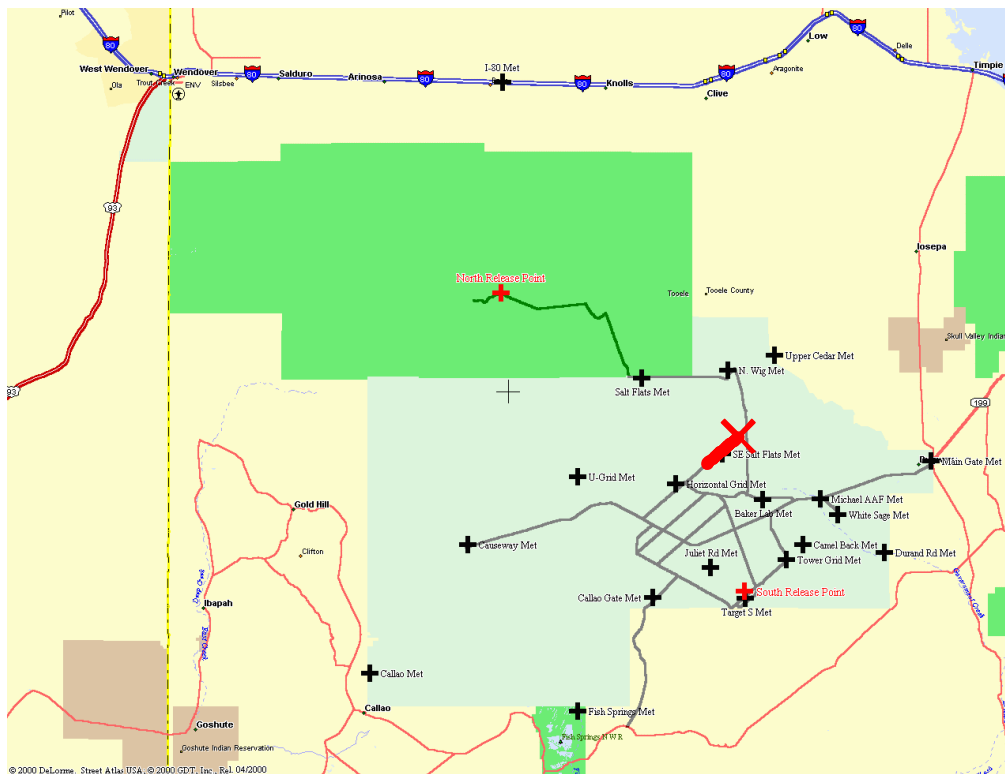
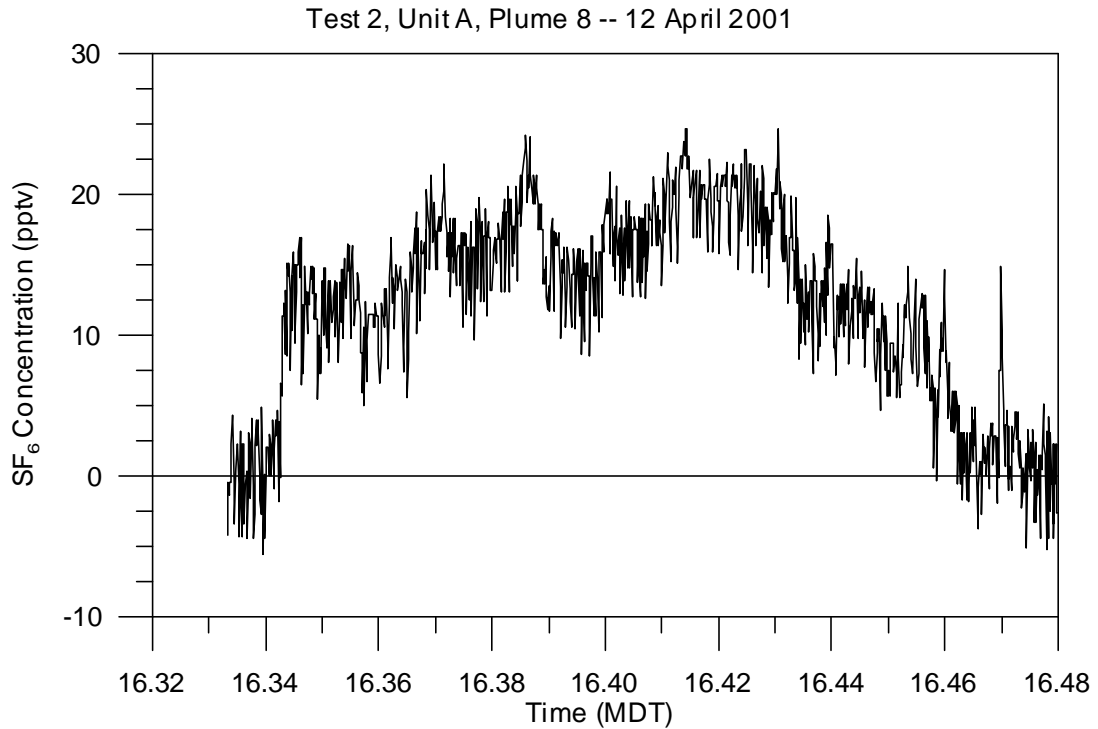


Figure A-51. SF₆ concentration of Plume 8 for Sampling Unit A during Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

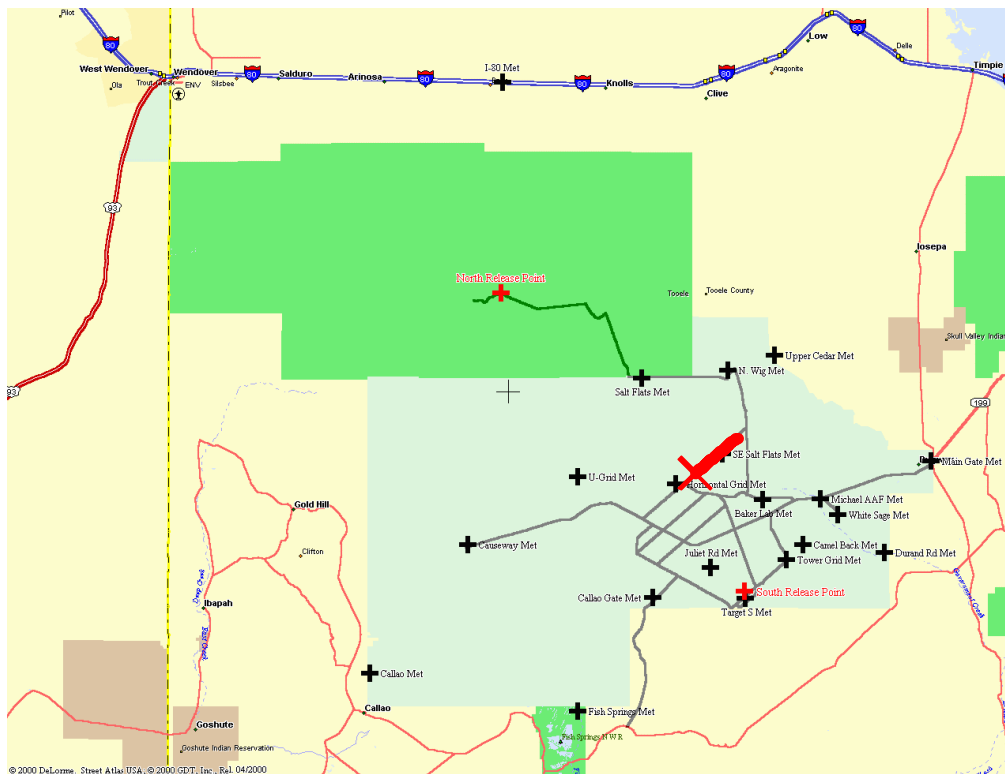
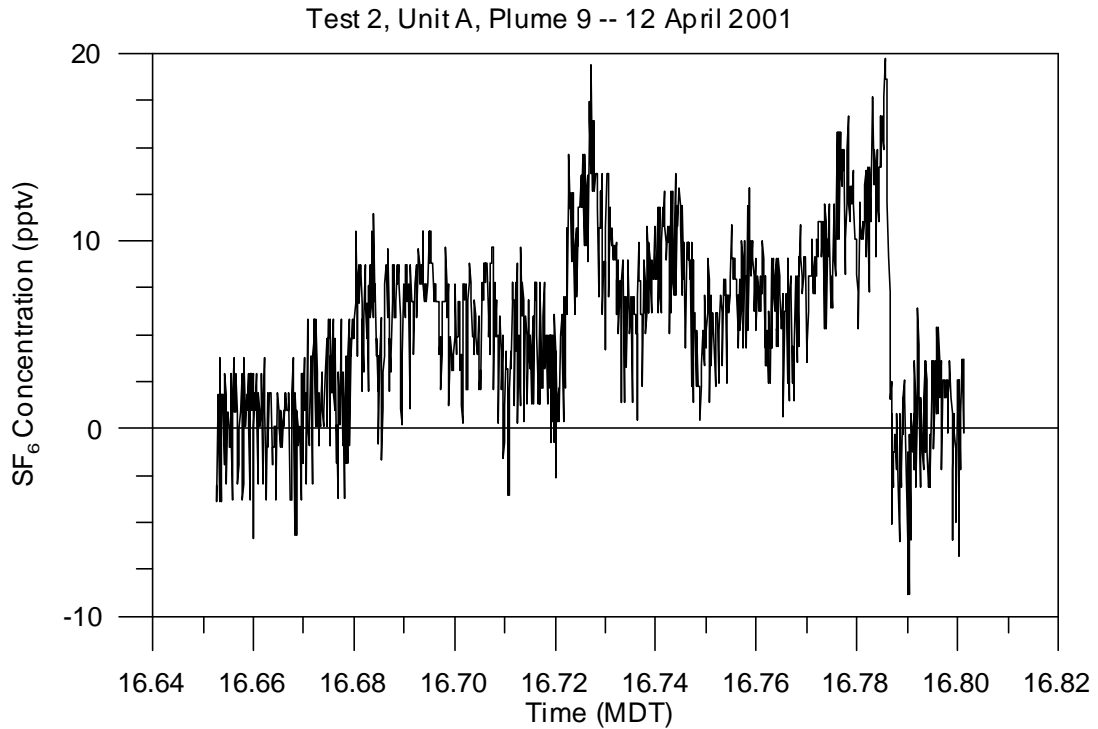


Figure A-52. SF₆ concentration of Plume 9 for Sampling Unit A during Test 2 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

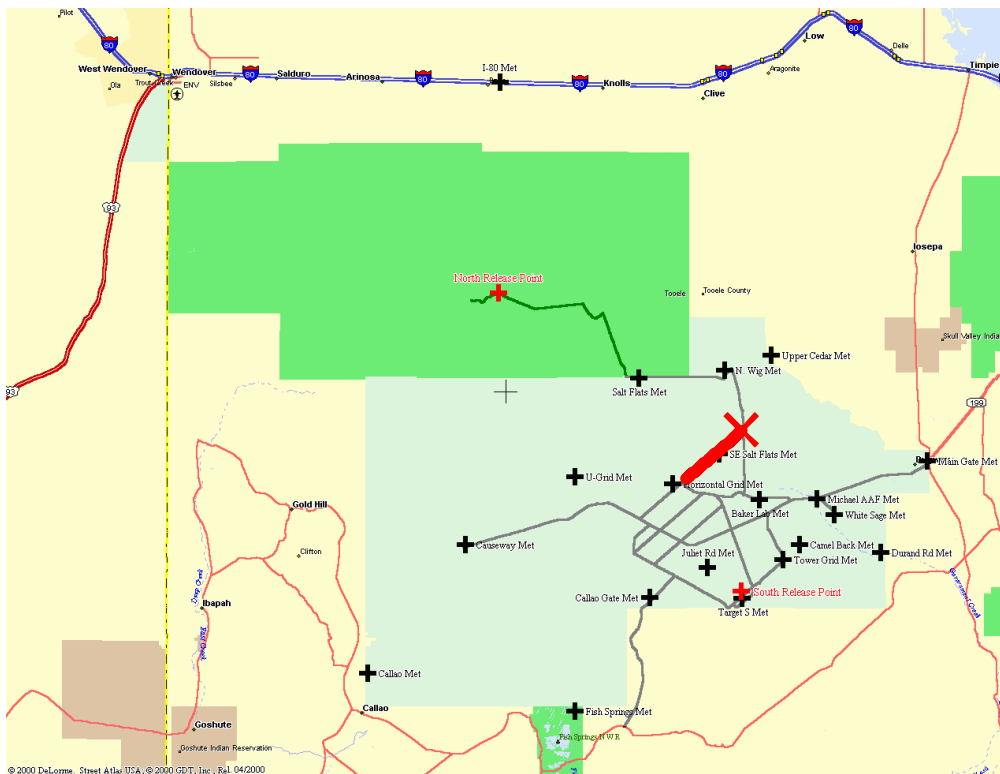
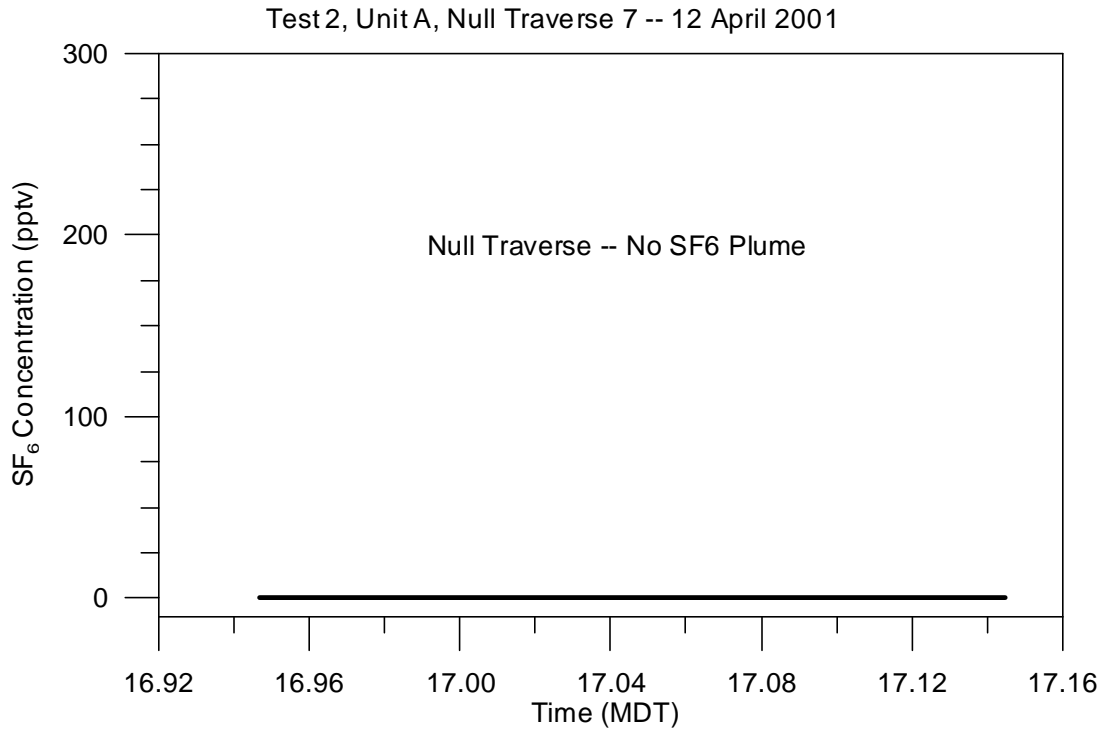


Figure A-53. Null sampling traverse 7 made by Sampling Unit A during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

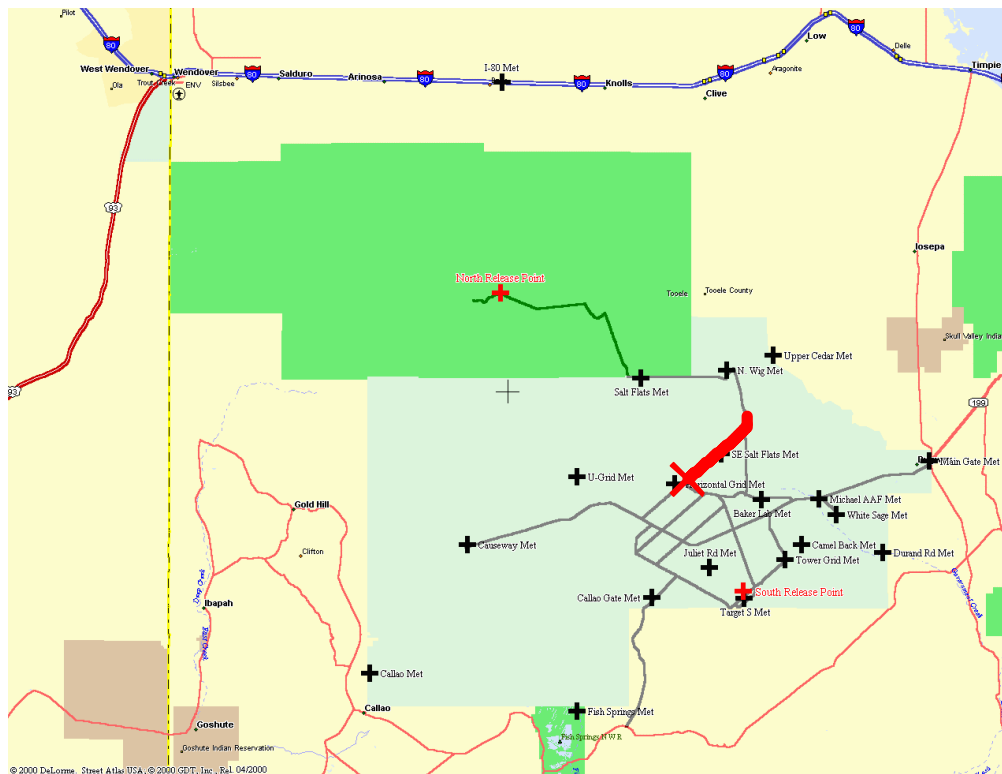
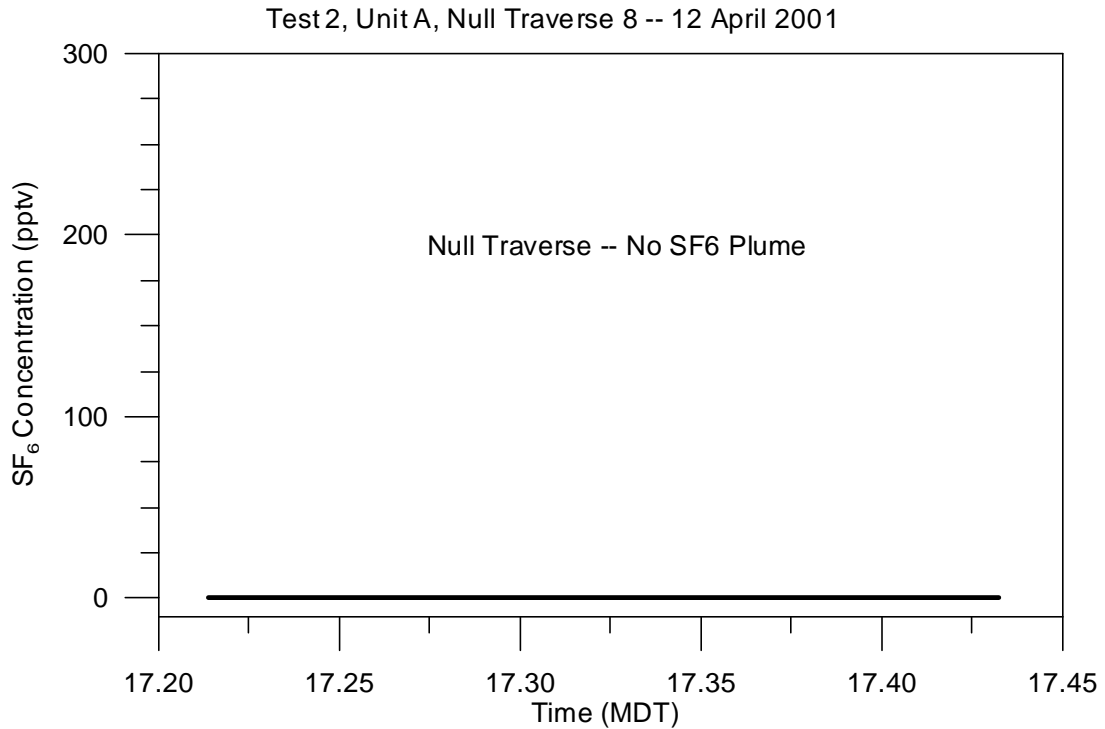


Figure A-54. Null sampling traverse 8 made by Sampling Unit A during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

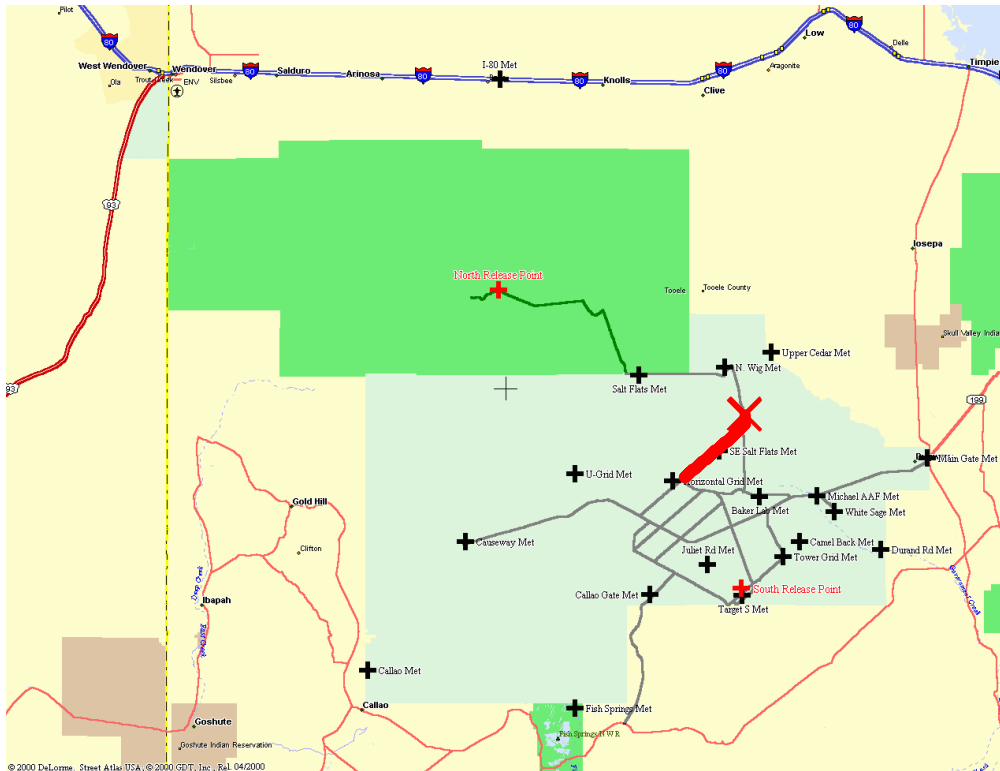
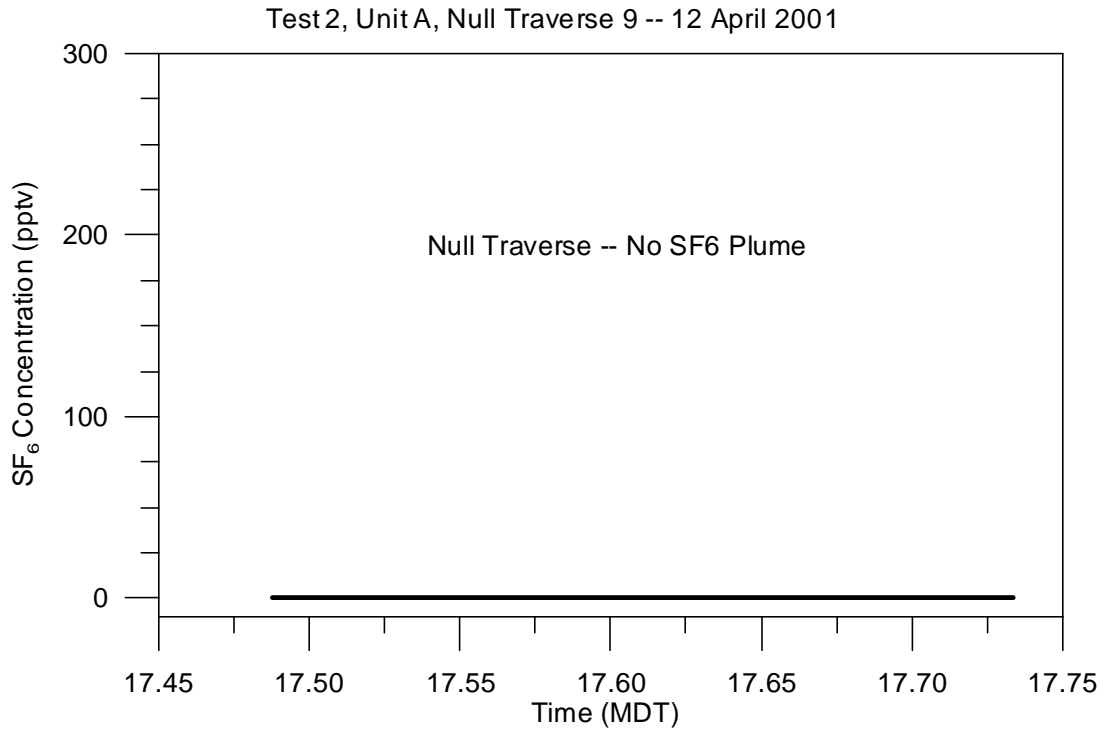


Figure A-55. Null sampling traverse 9 made by Sampling Unit A during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 2
Sampling Unit B

Table A-20. Test 2 Sampling Unit B sampling traverses yielding no detectable SF₆ (null pass).
(Sampling Unit B did not encounter any SF₆ during Test 2.)

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	12:23	12:36
2	12:40	12:54
3	12:58	13:11
4	13:17	13:41
5	13:50	14:07
6	14:16	14:35
7	17:18	17:35
8	17:37	17:54
9	17:59	18:06
10	18:14	18:29

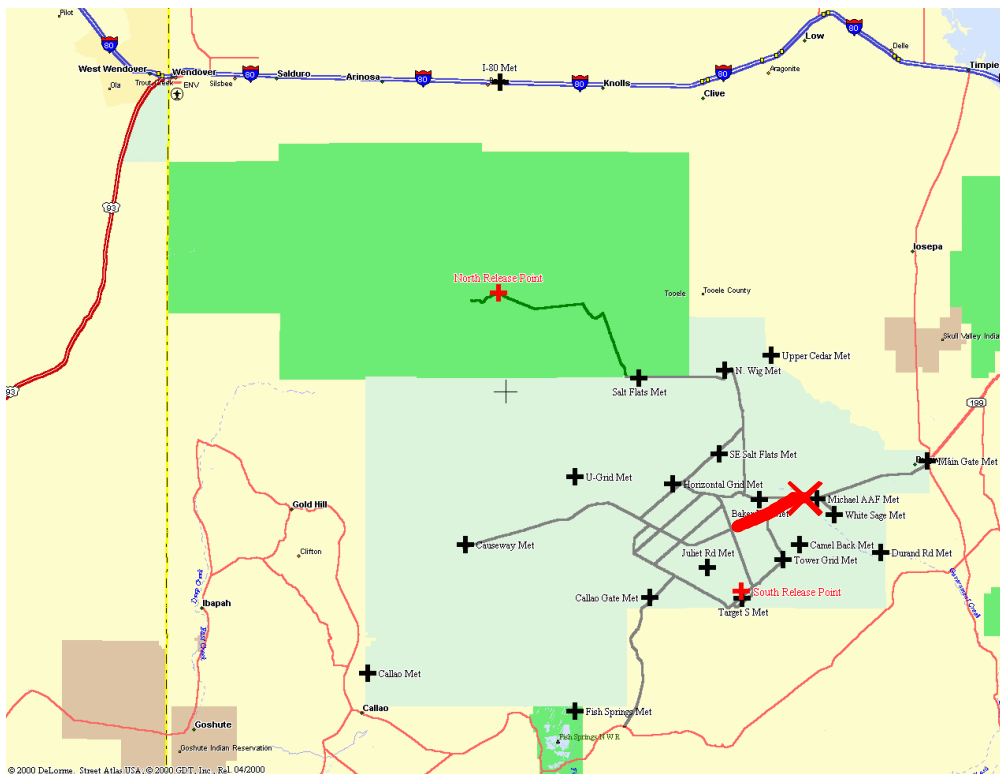
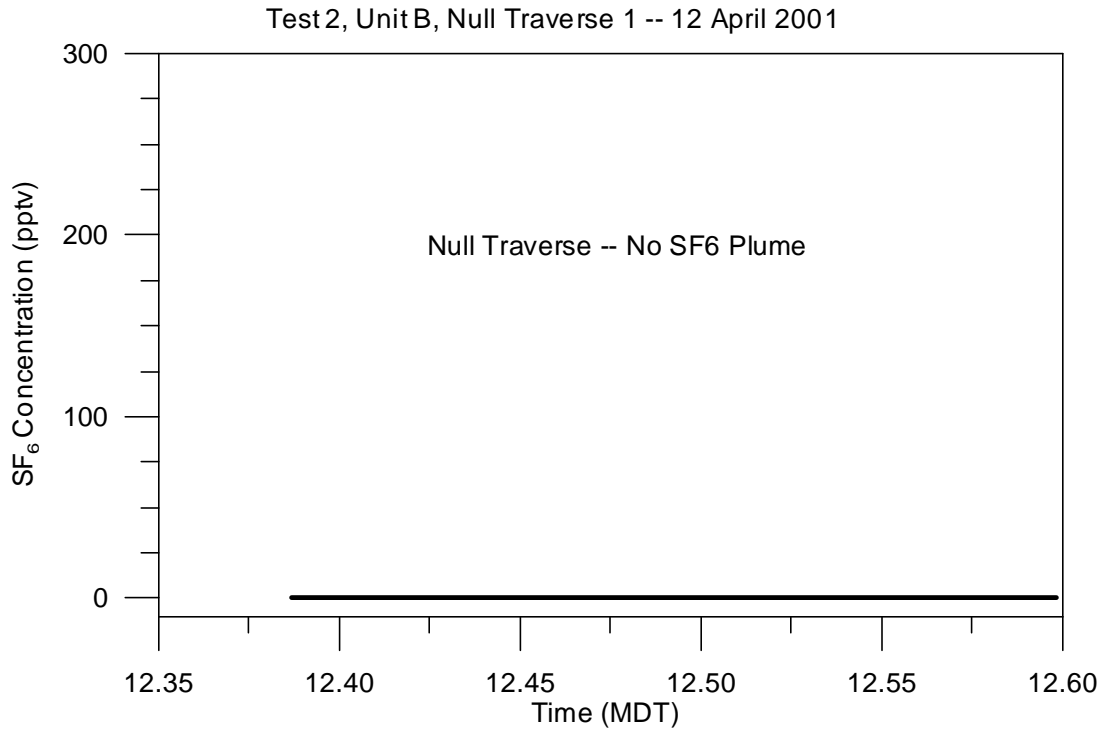


Figure A-56. Null sampling traverse 1 made by Sampling Unit B during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

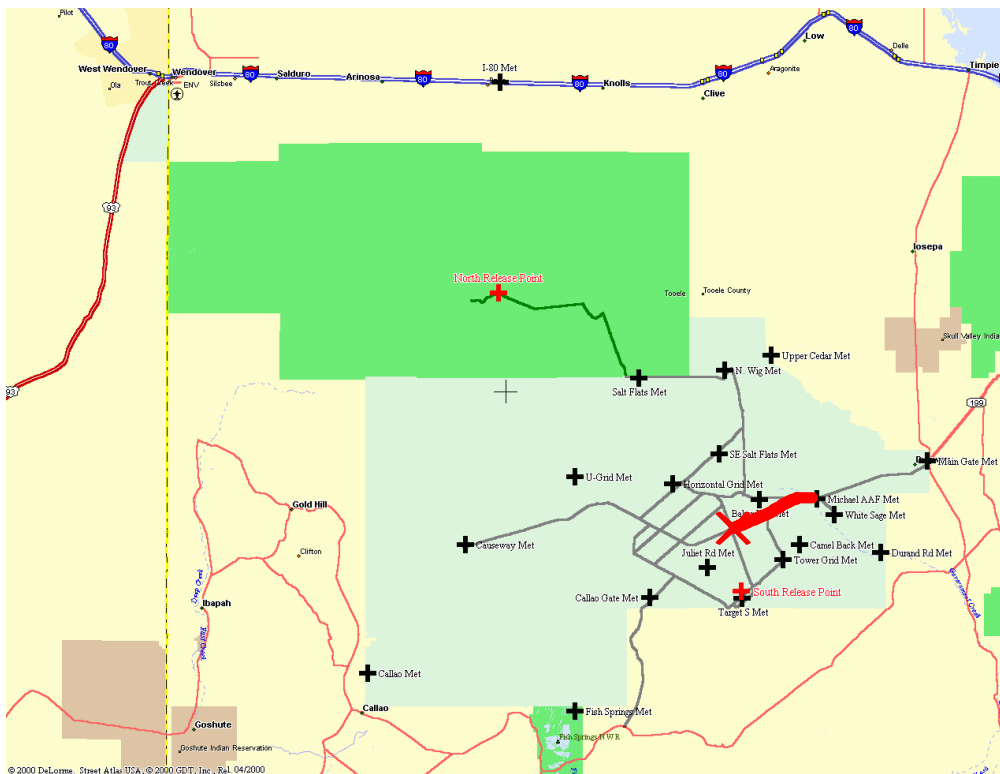
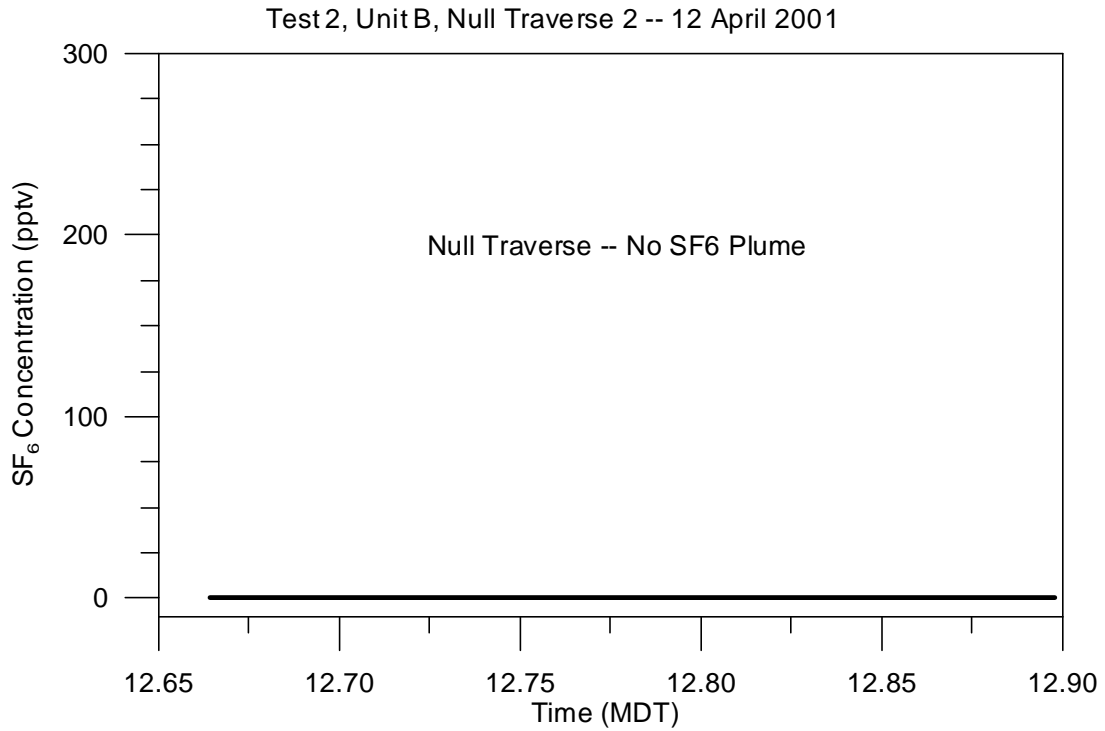


Figure A-57. Null sampling traverse 2 made by Sampling Unit B during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

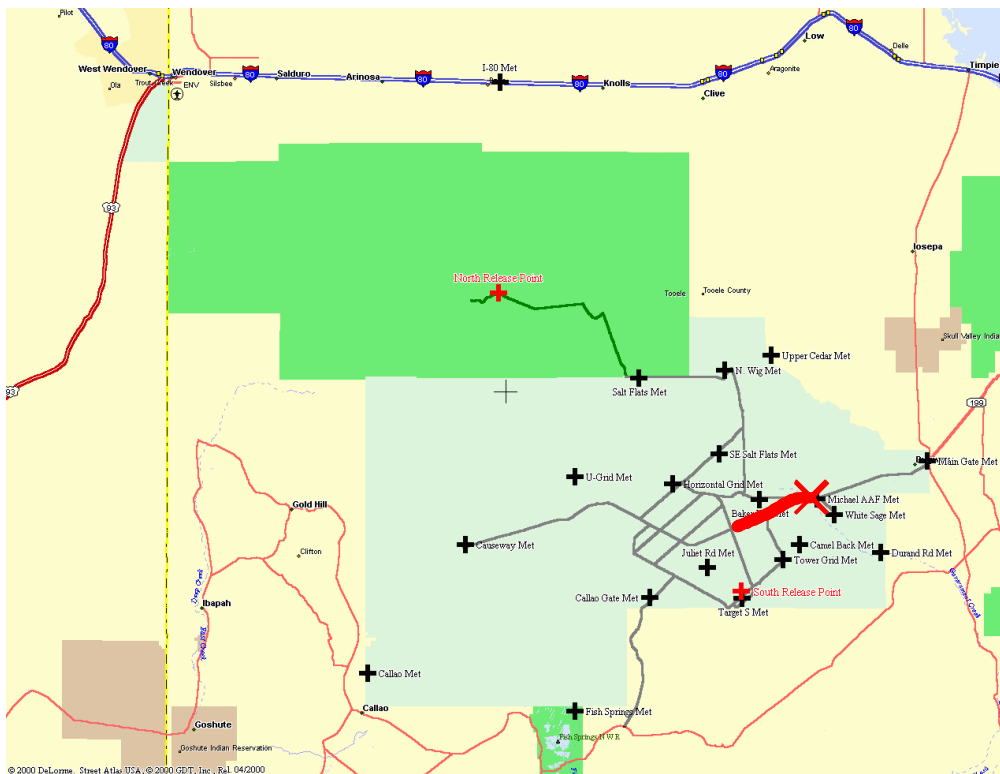
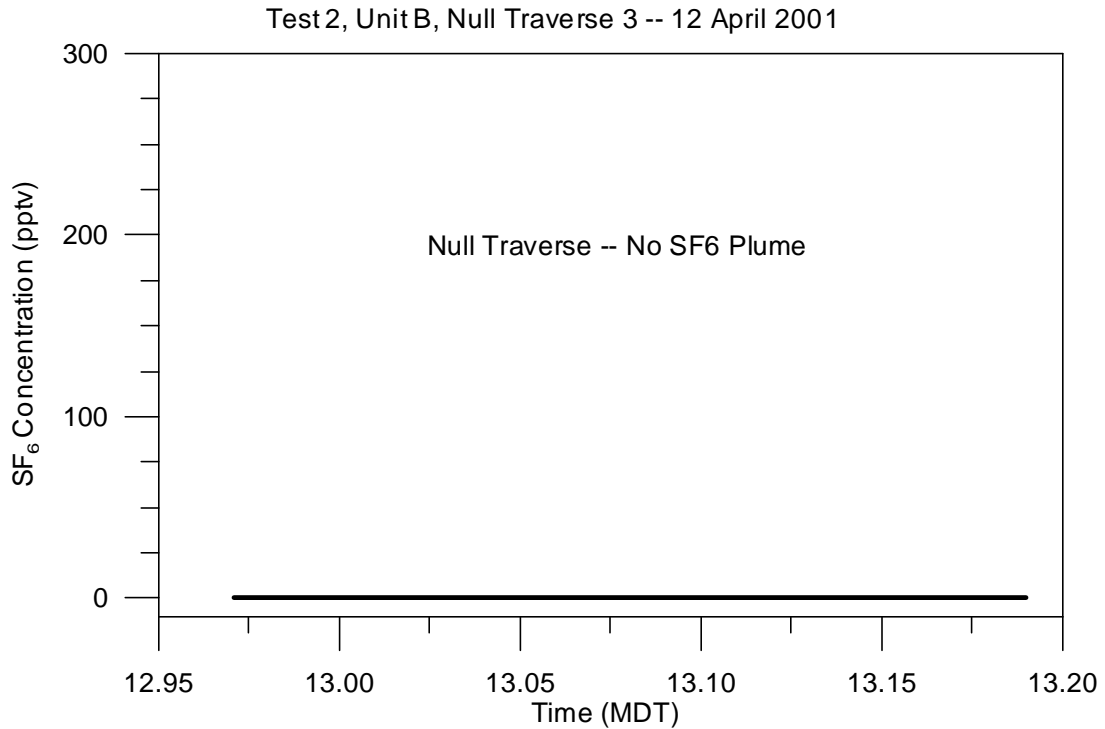


Figure A-58. Null sampling traverse 3 made by Sampling Unit B during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

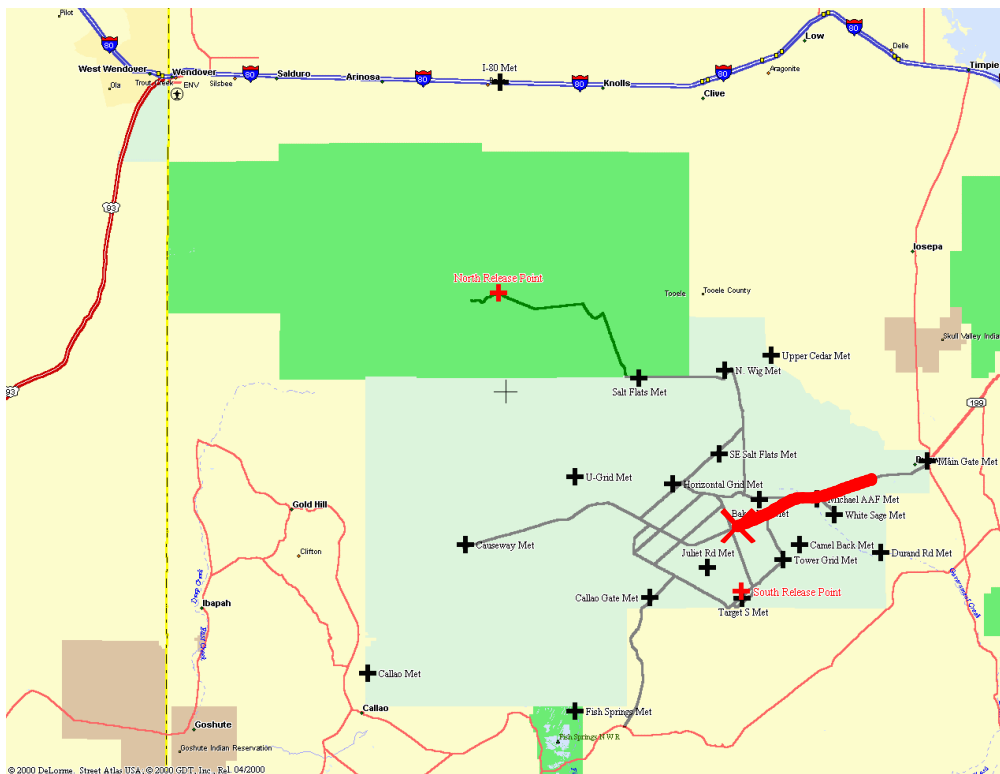
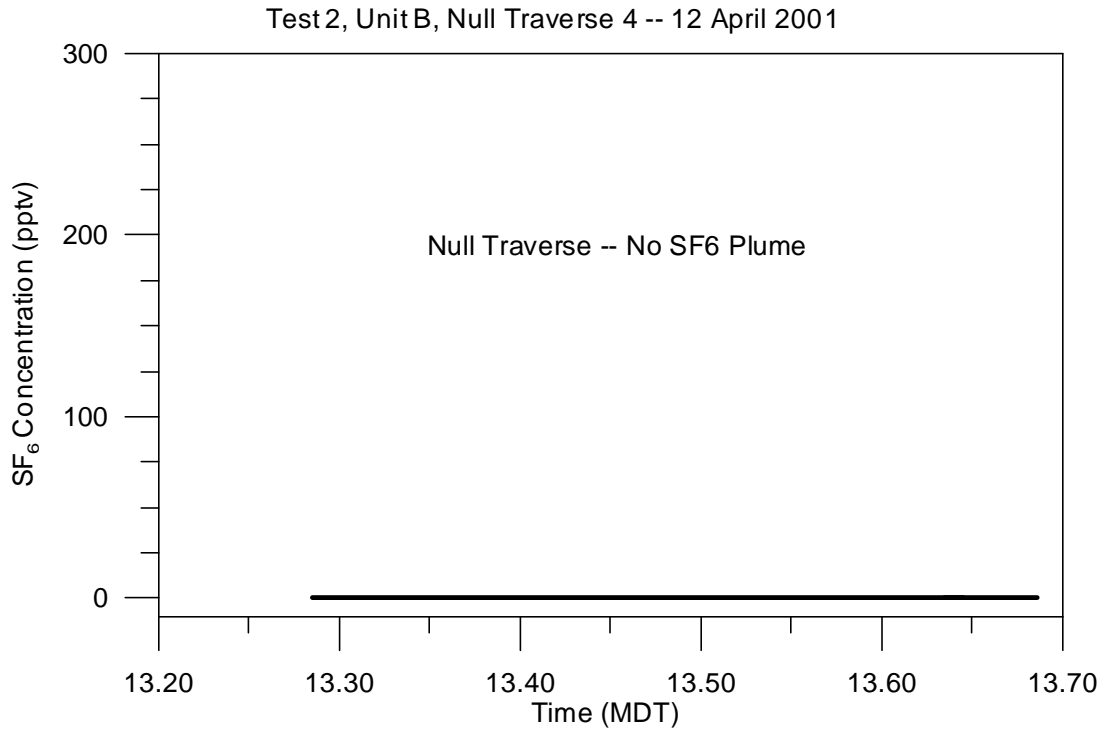


Figure A-59. Null sampling traverse 4 made by Sampling Unit B during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

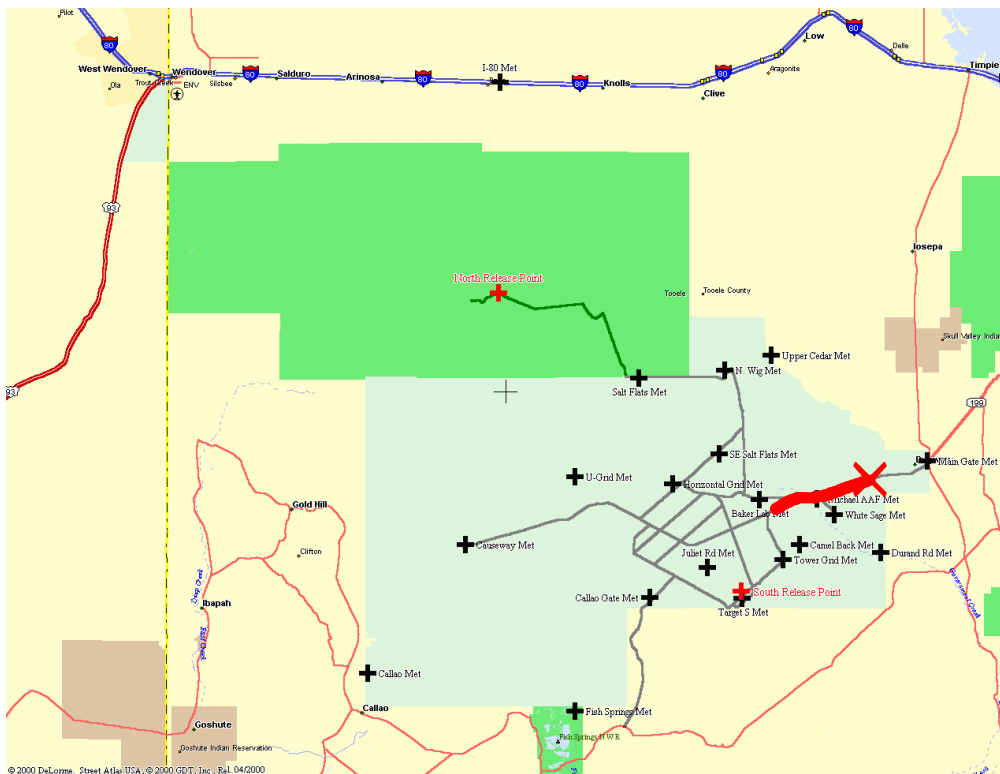
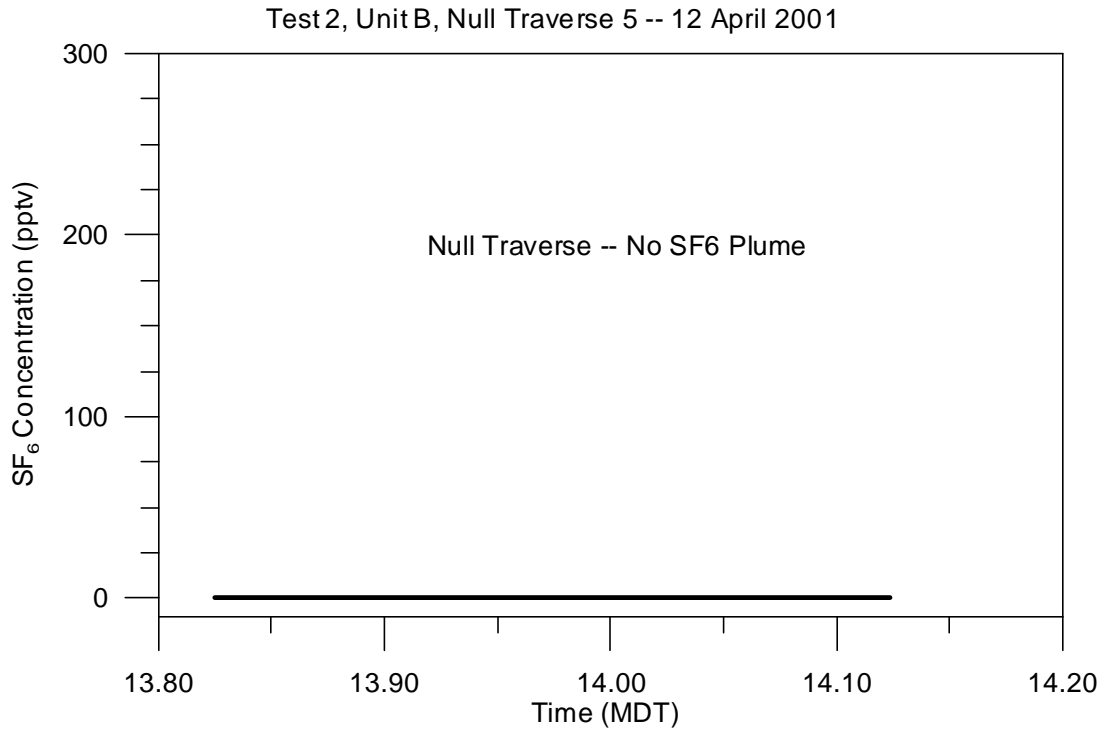


Figure A-60. Null sampling traverse 5 made by Sampling Unit B during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

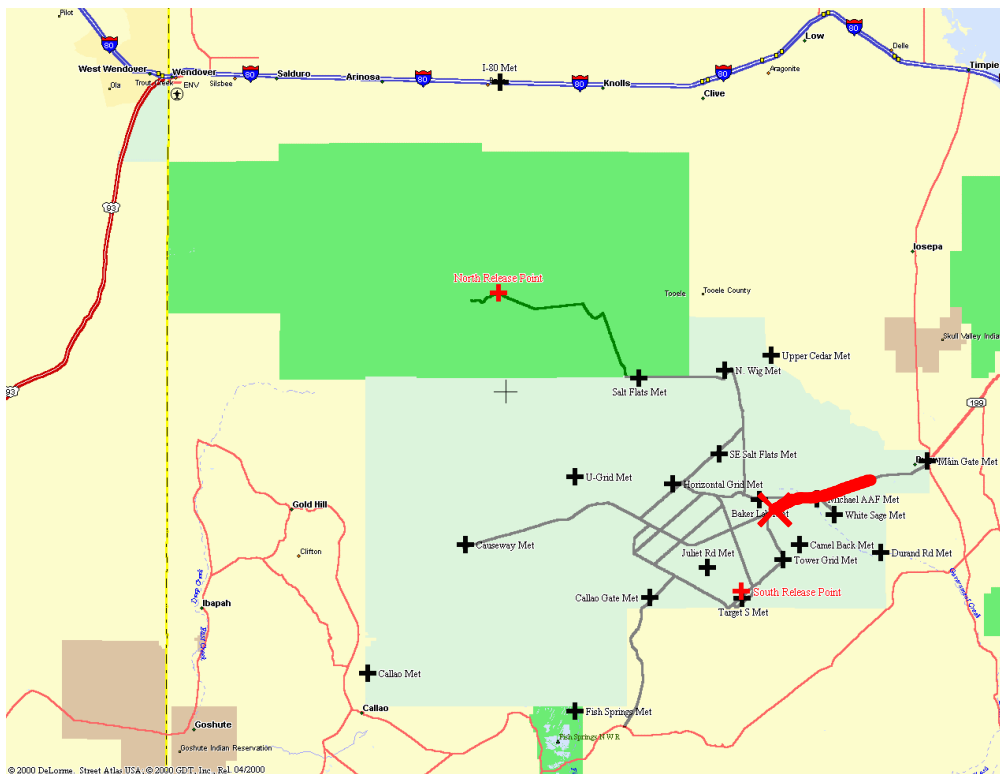
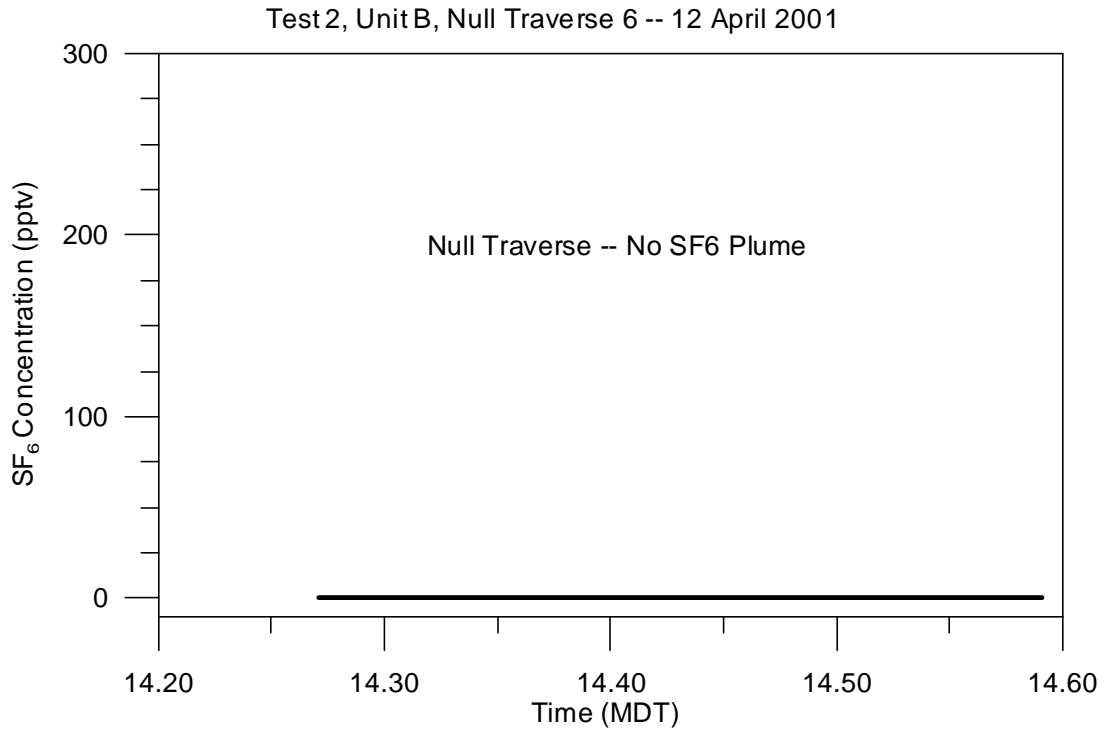


Figure A-61. Null sampling traverse 6 made by Sampling Unit B during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

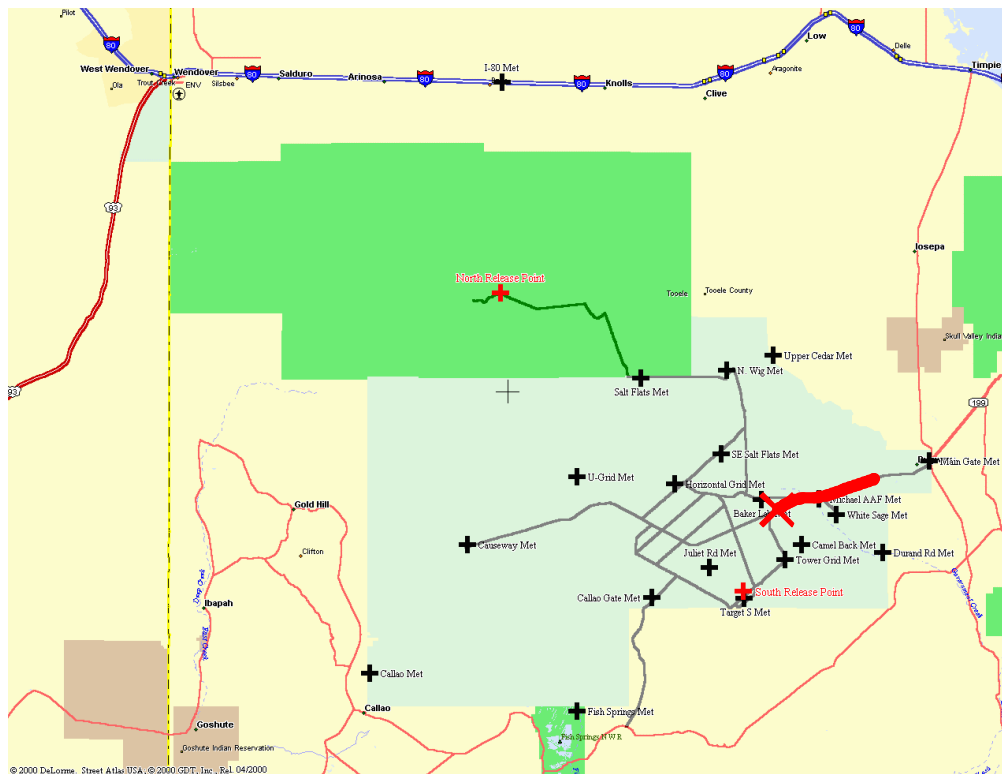
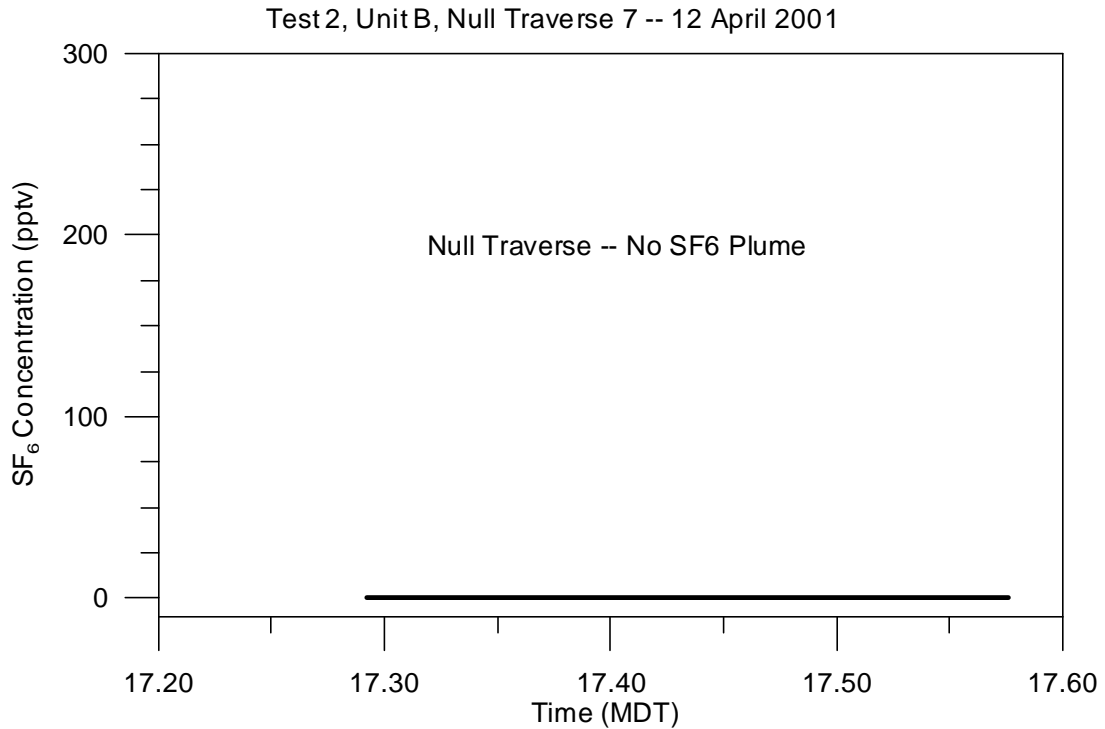


Figure A-62. Null sampling traverse 7 made by Sampling Unit B during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

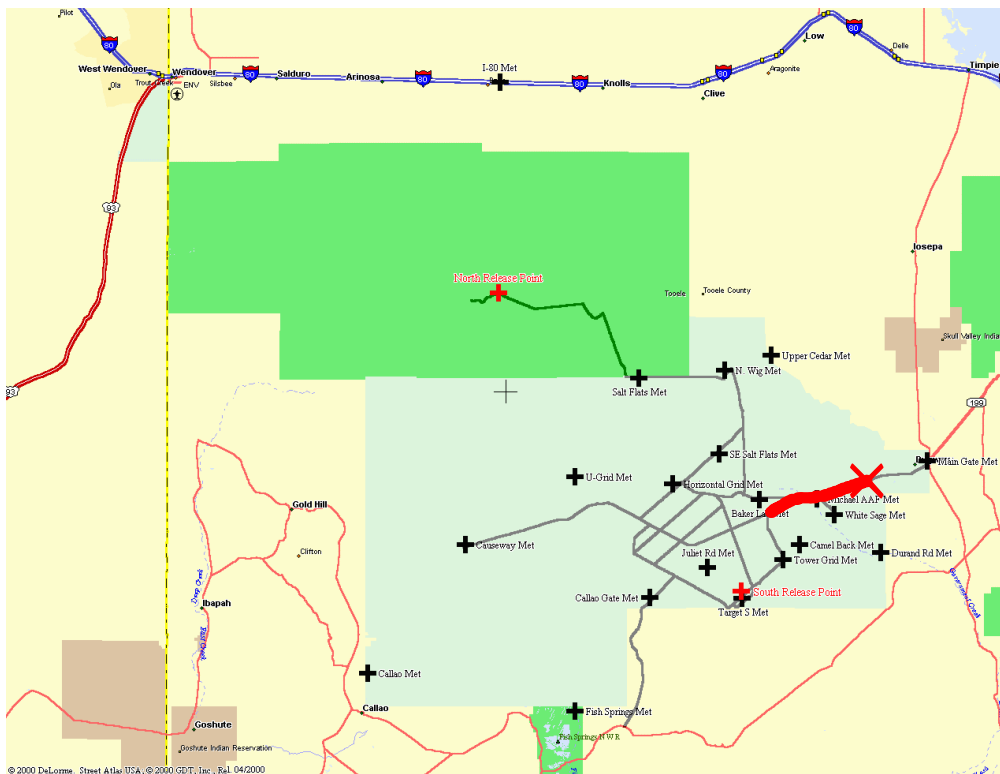
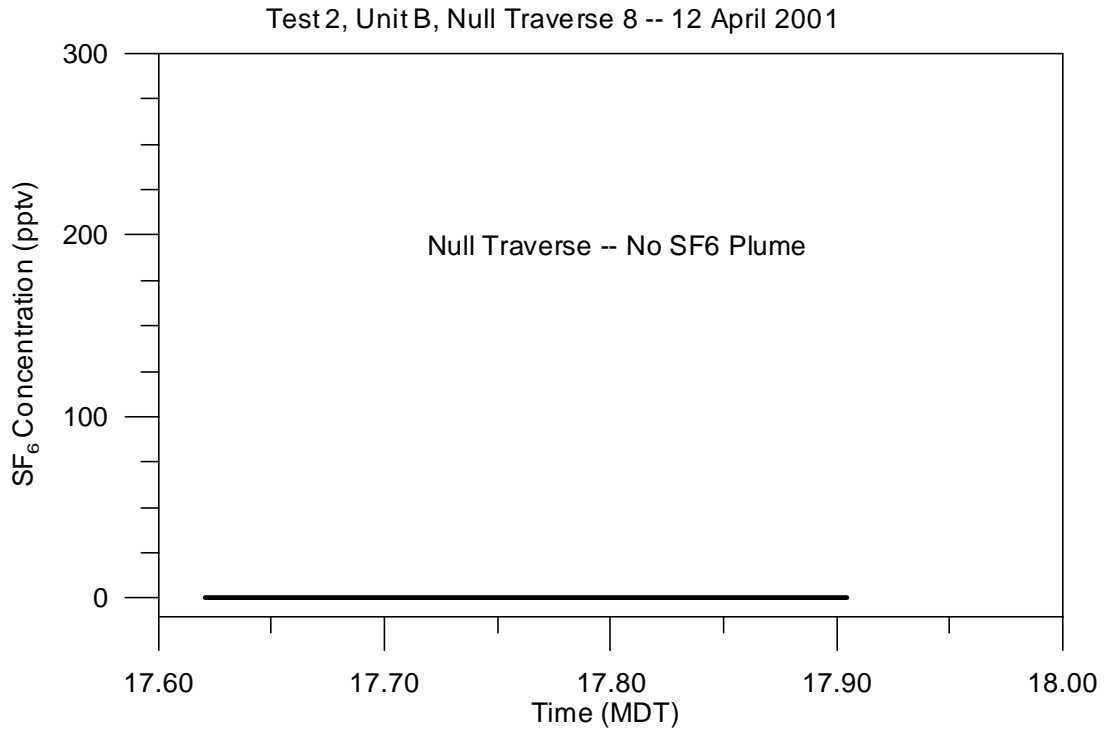


Figure A-63. Null sampling traverse 8 made by Sampling Unit B during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

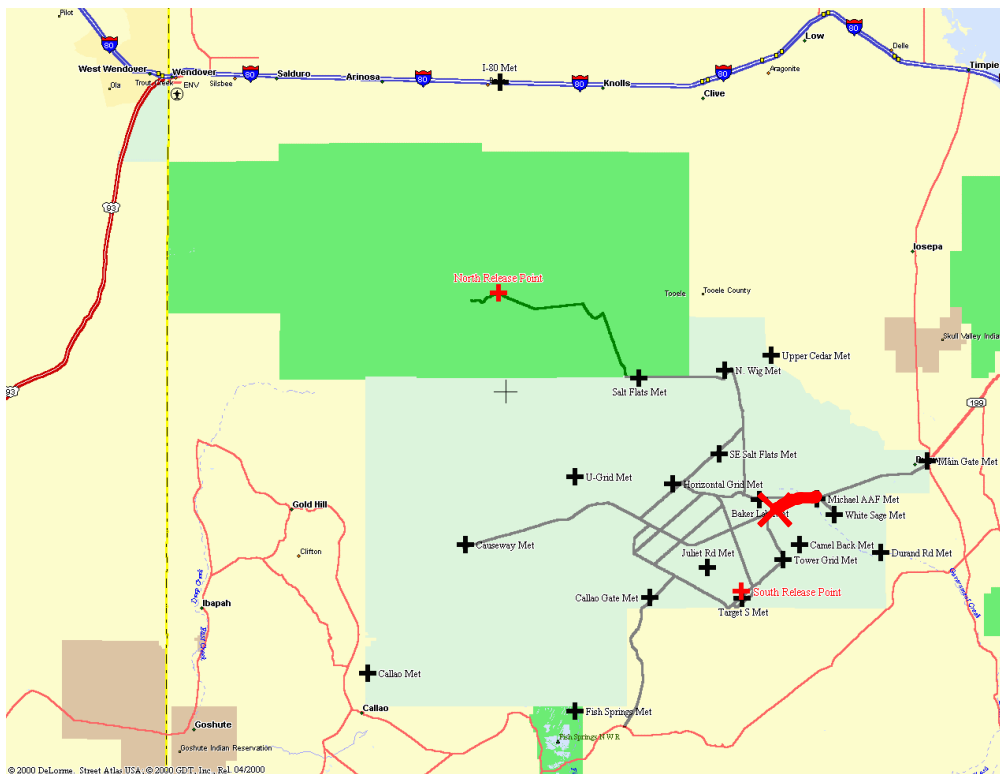
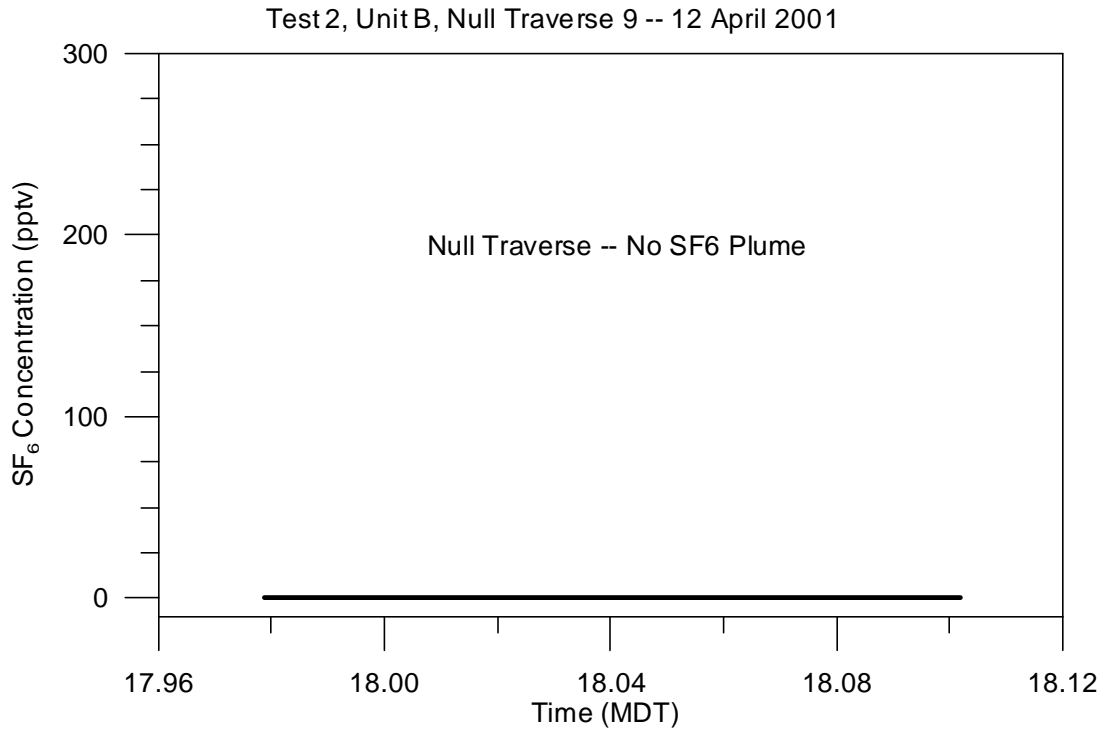


Figure A-64. Null sampling traverse 9 made by Sampling Unit B during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

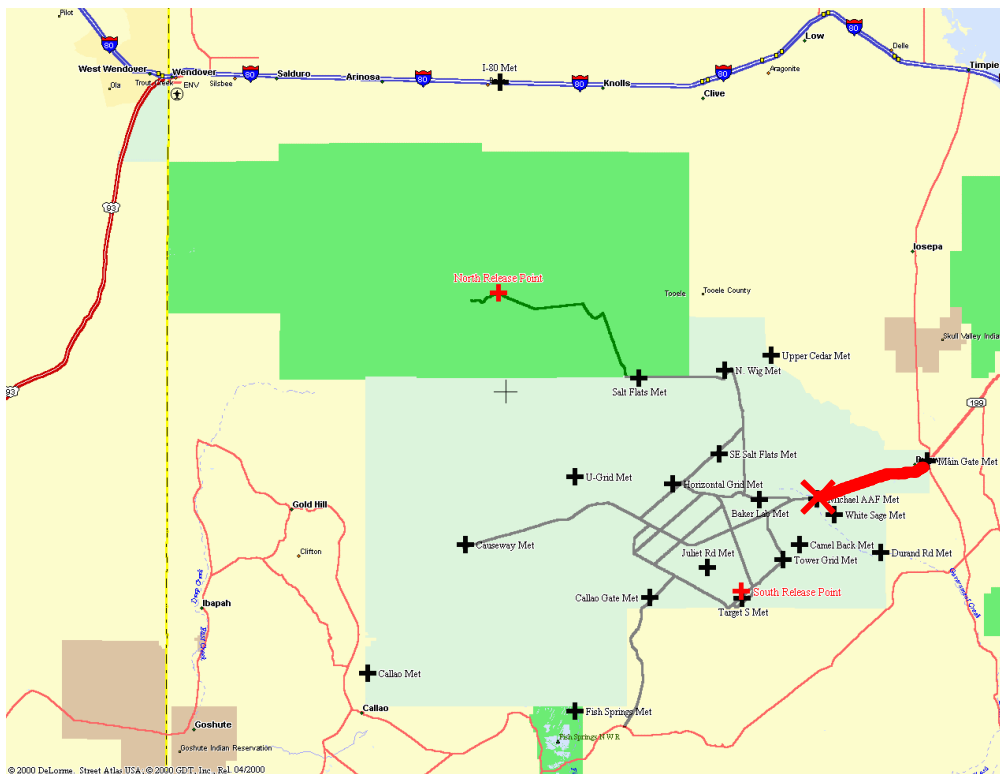
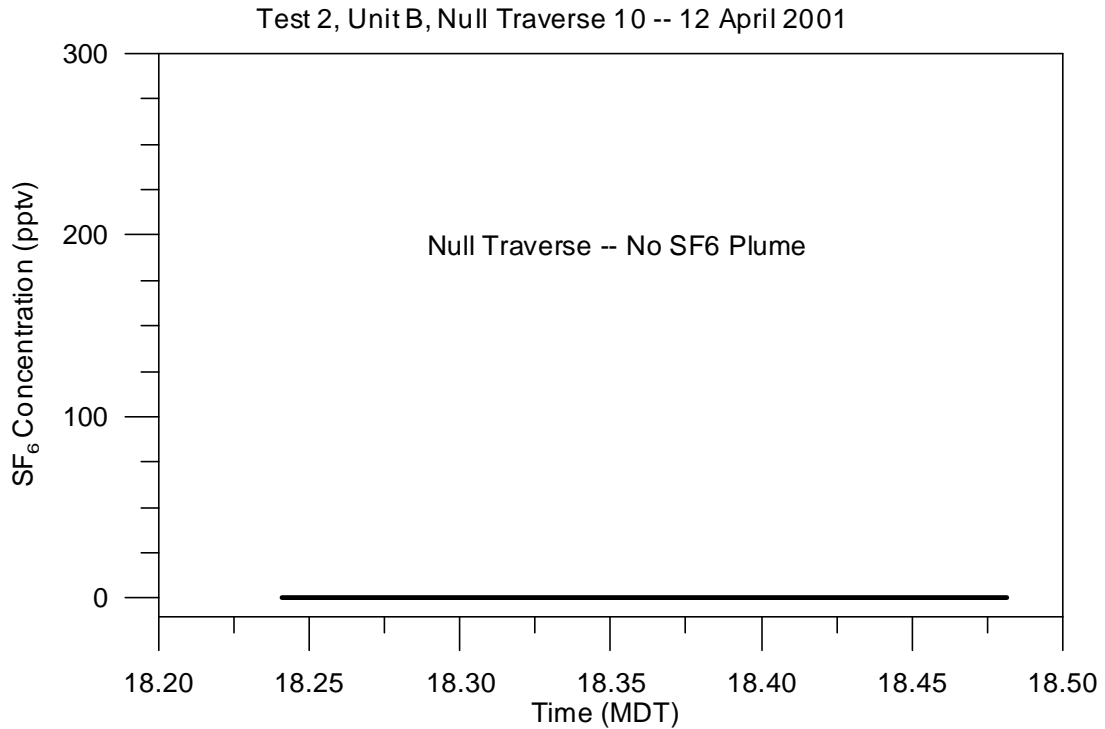


Figure A-65. Null sampling traverse 10 made by Sampling Unit B during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 2
Sampling Unit C

Table A-21. Test 2 Sampling Unit C sampling traverses yielding no detectable SF₆ (null pass).
(Sampling Unit C did not encounter any SF₆ during Test 2.)

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	12:29	12:53
2	12:54	13:16
3	13:19	13:39
4	13:40	14:02
5	14:06	14:28
6	14:33	14:43
7	14:57	15:08
8	15:13	15:32
9	15:35	15:46
10	15:47	15:59
11	16:00	16:11
12	16:12	16:32
13	16:40	16:53
14	16:59	17:06
15	17:36	17:54
16	17:54	18:00

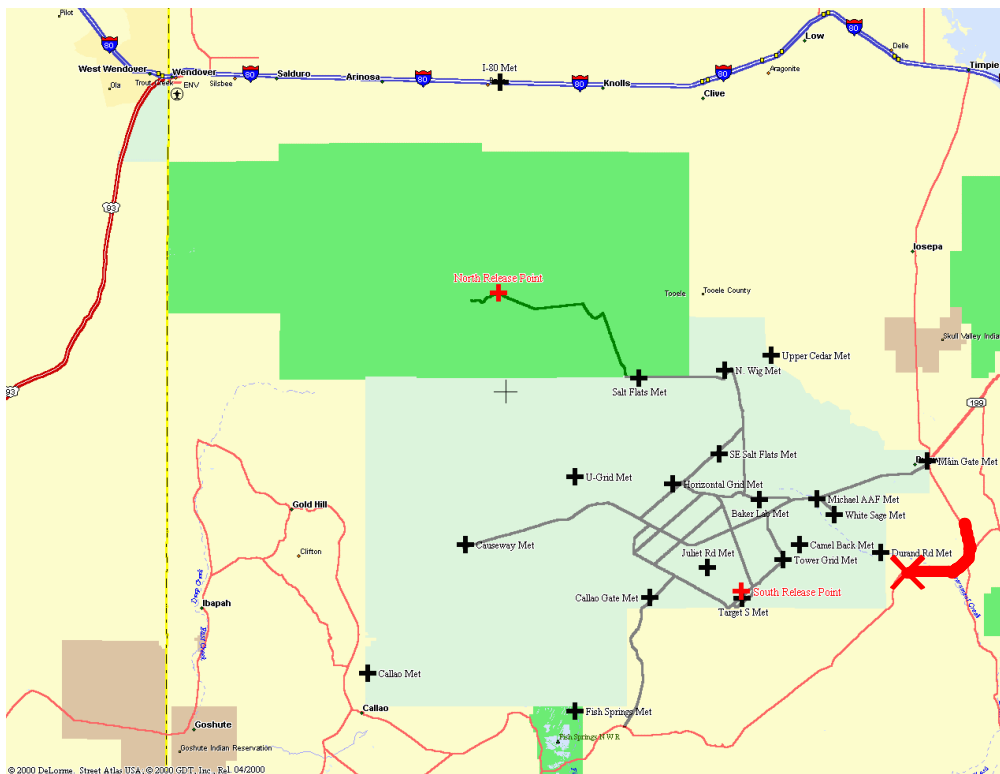
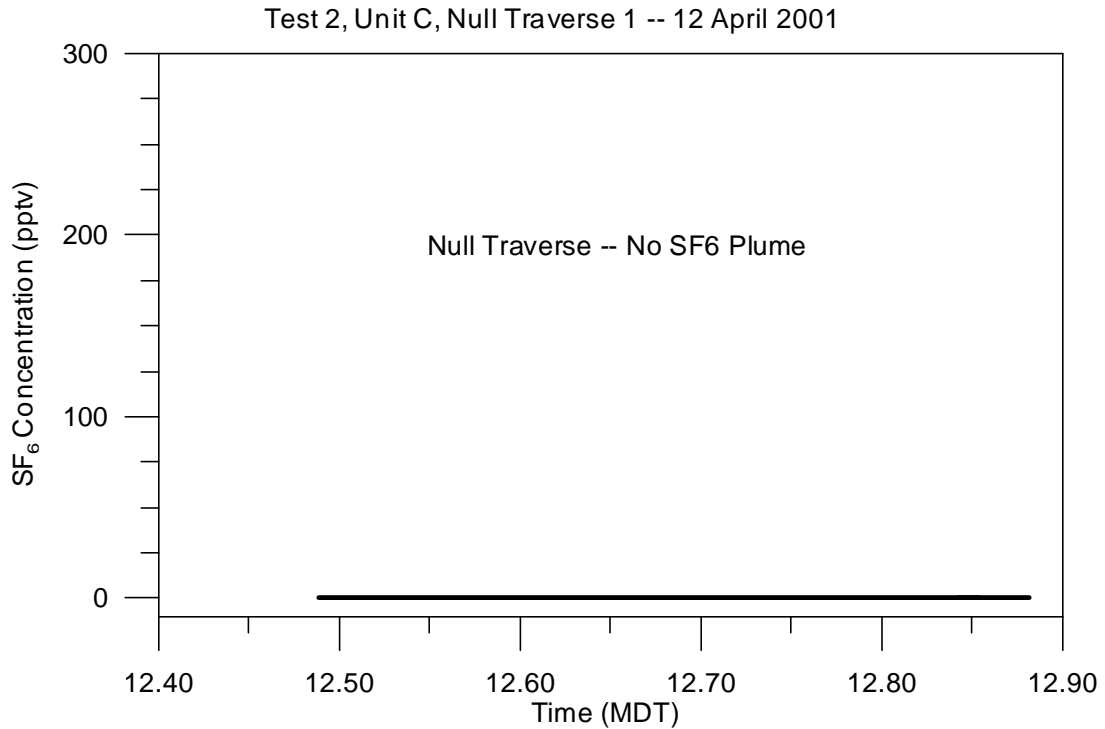


Figure A-66. Null sampling traverse 1 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

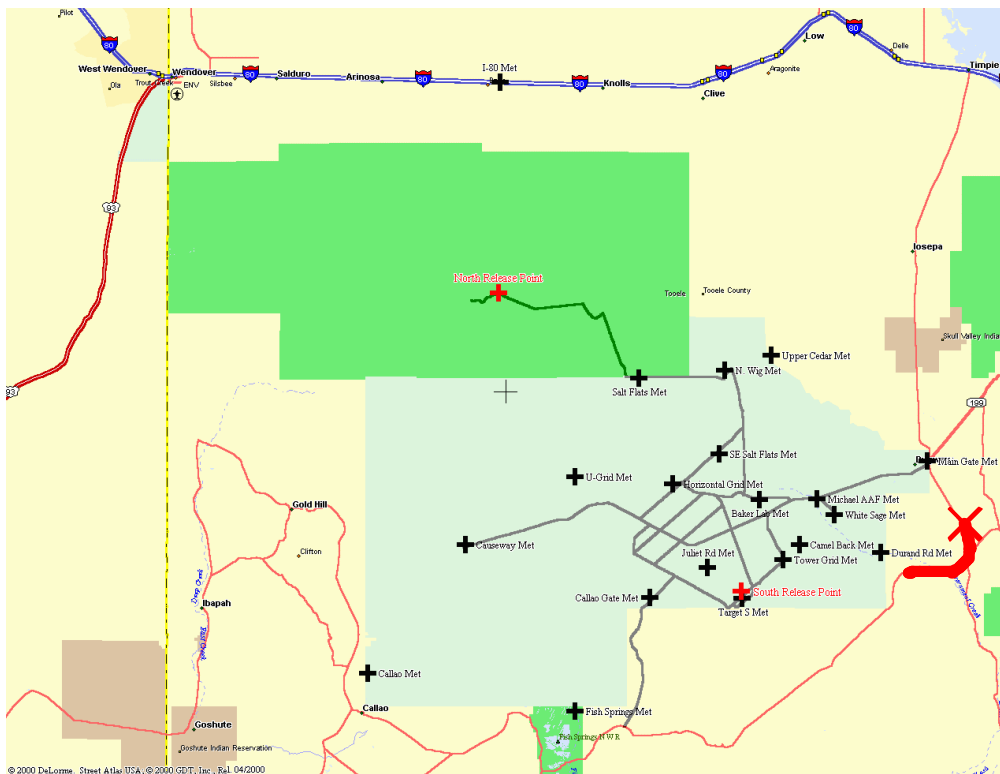
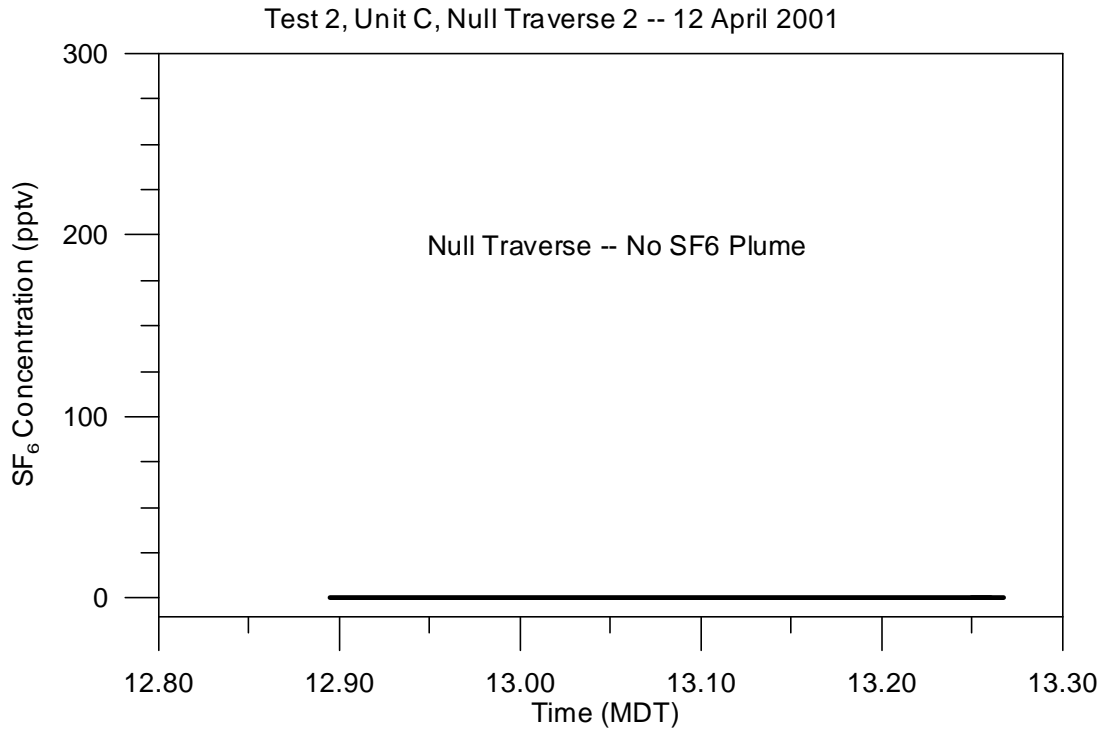


Figure A-67. Null sampling traverse 2 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

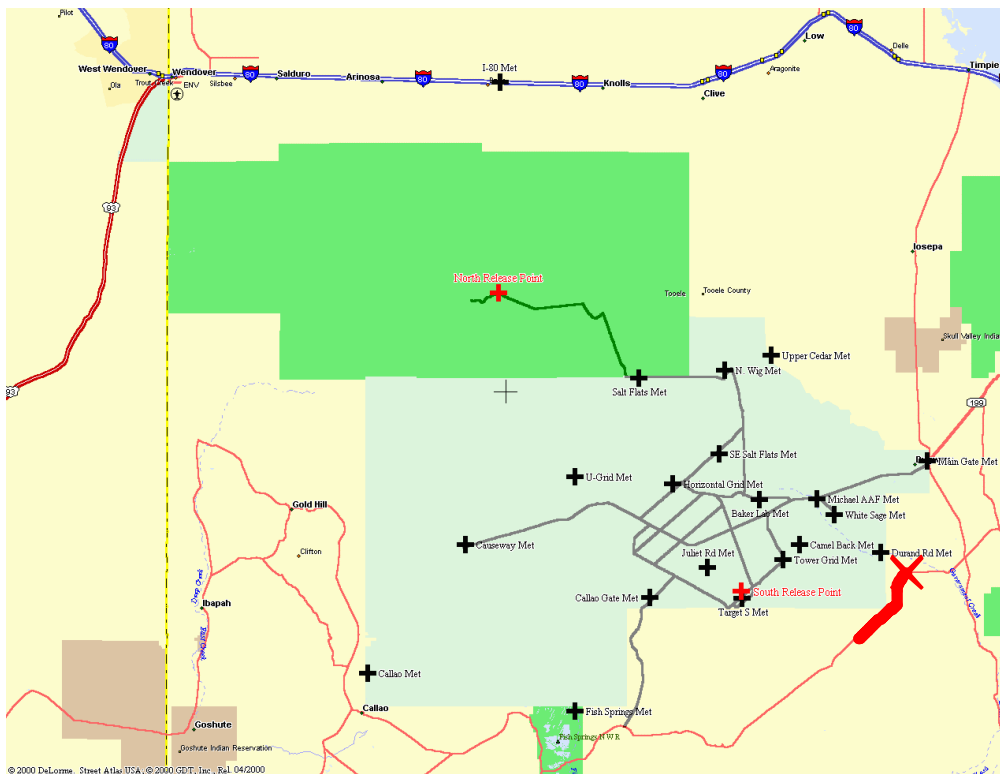
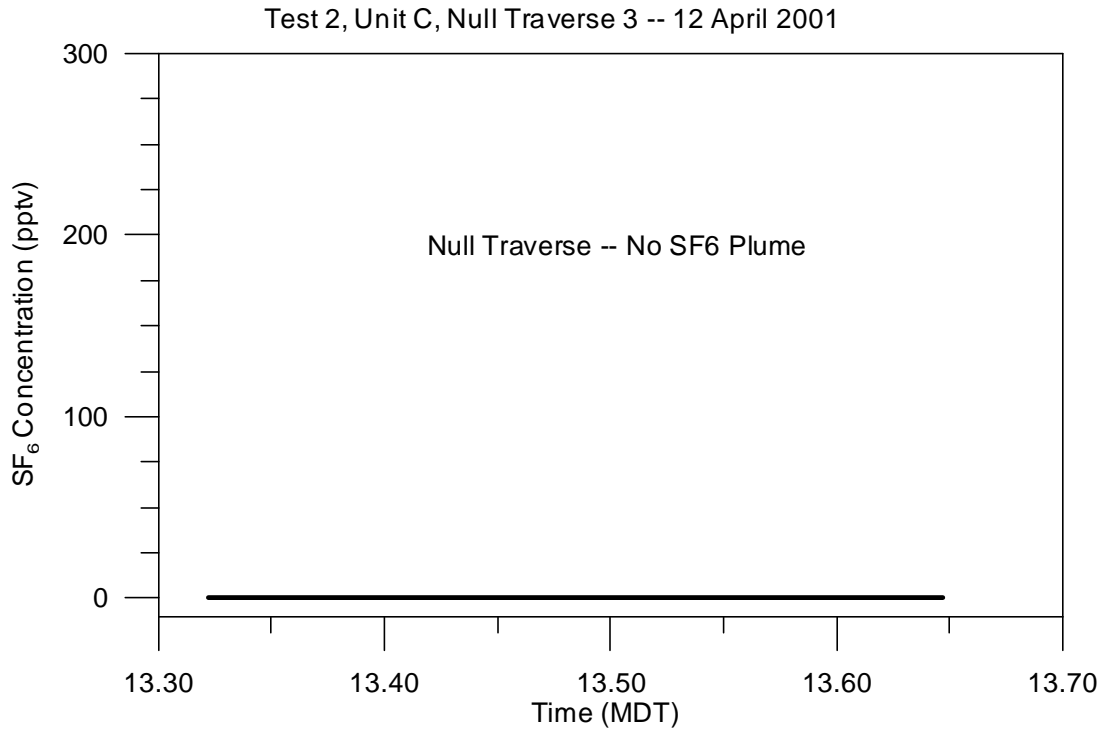


Figure A-68. Null sampling traverse 3 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

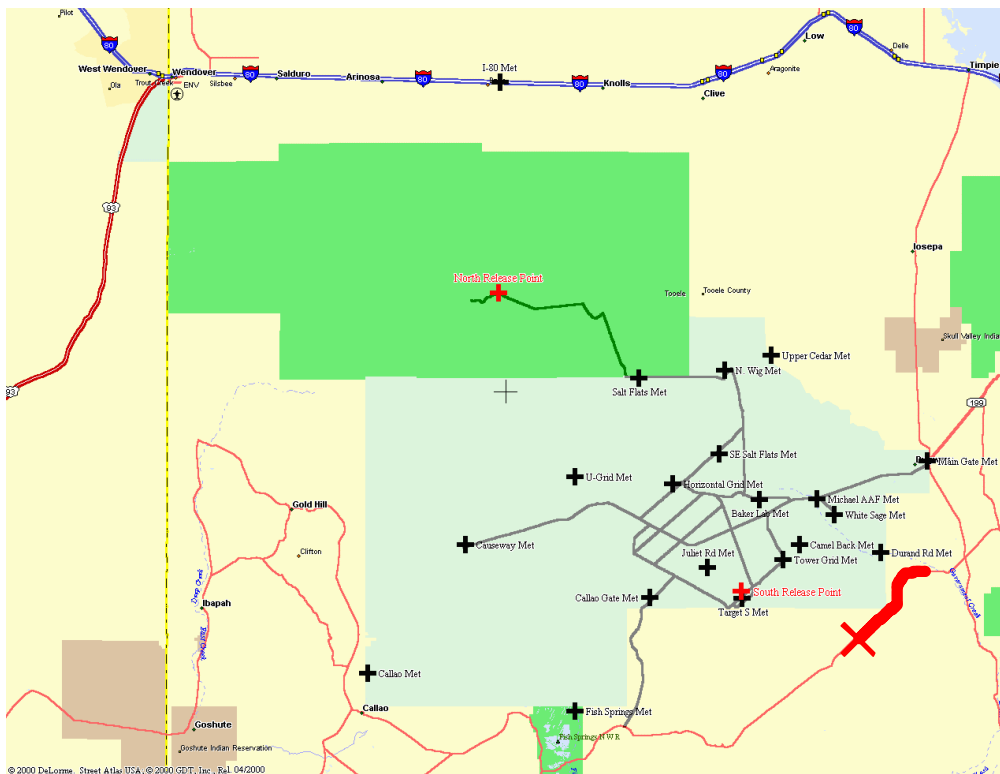
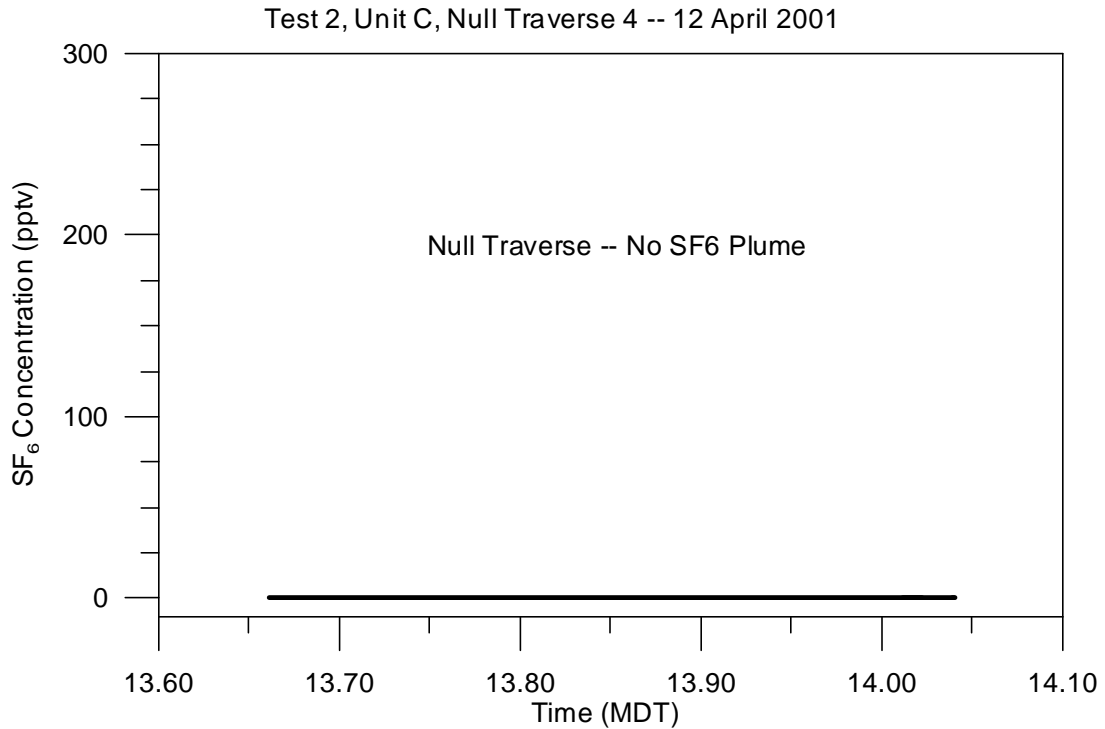


Figure A-69. Null sampling traverse 4 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

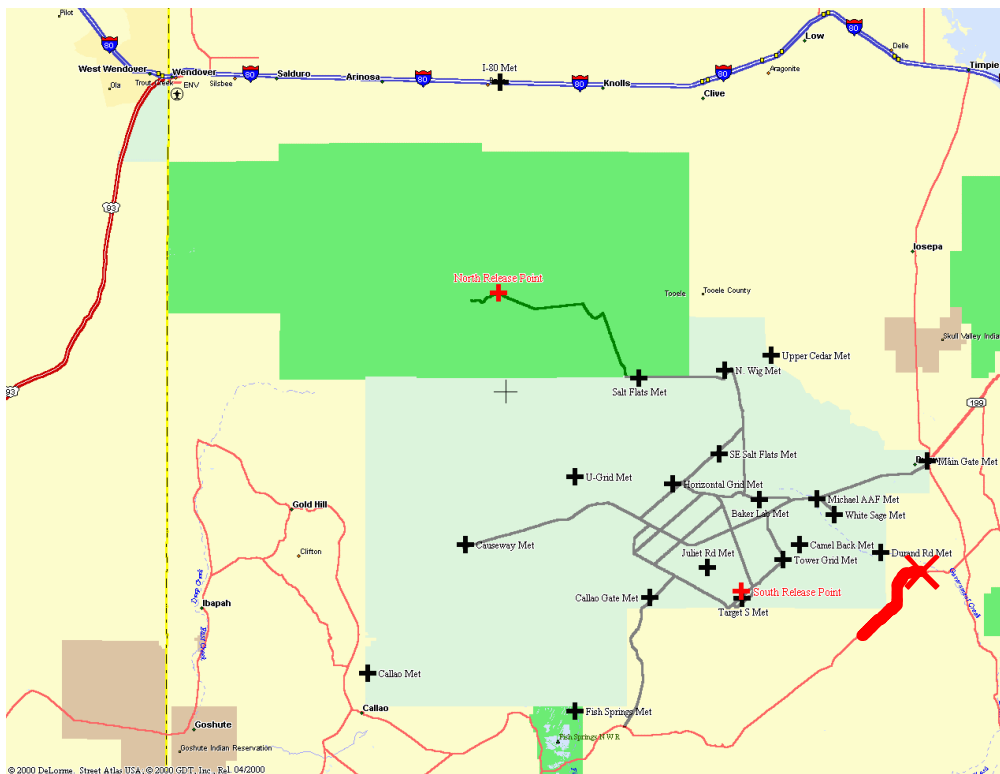
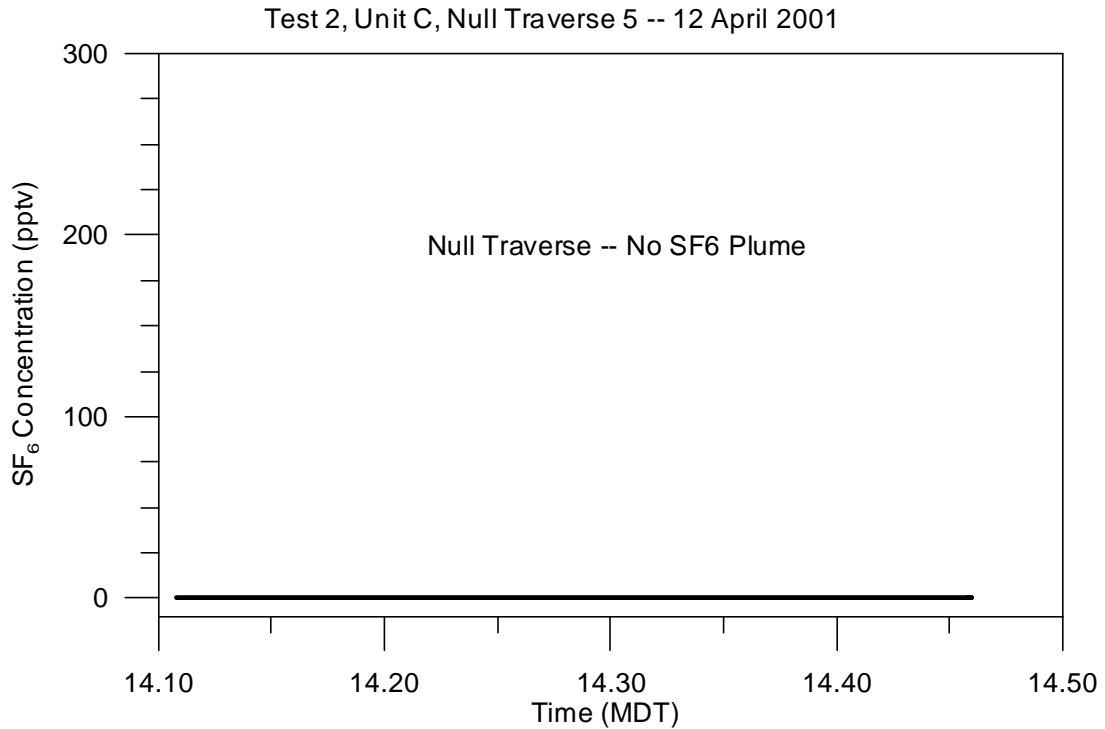


Figure A-70. Null sampling traverse 5 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

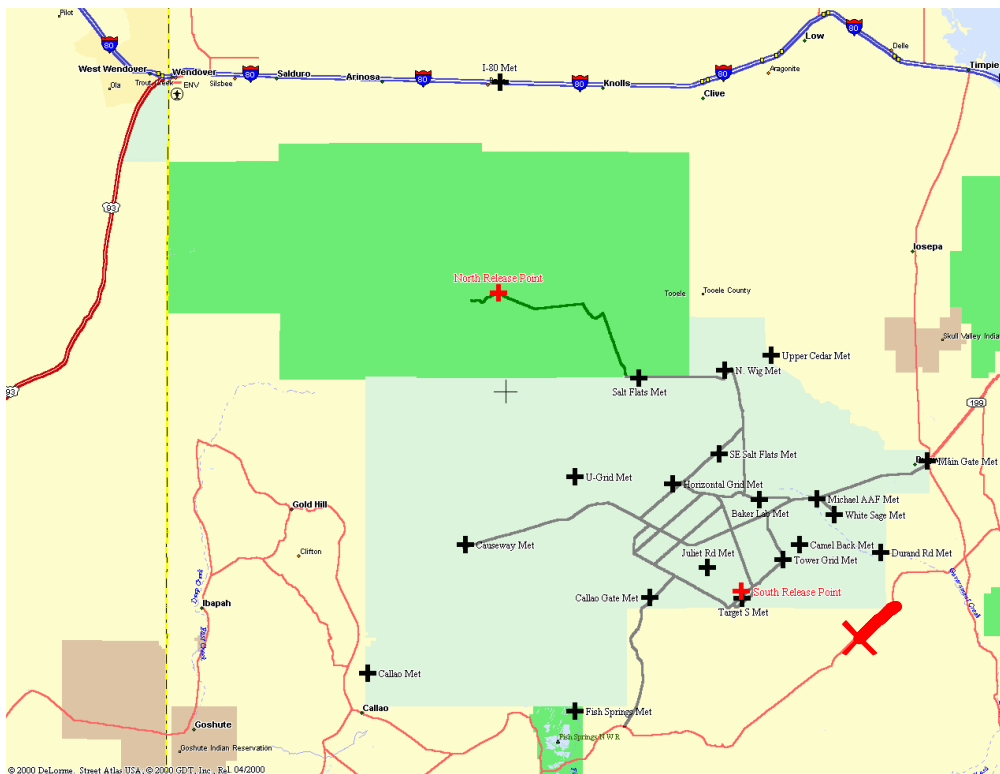
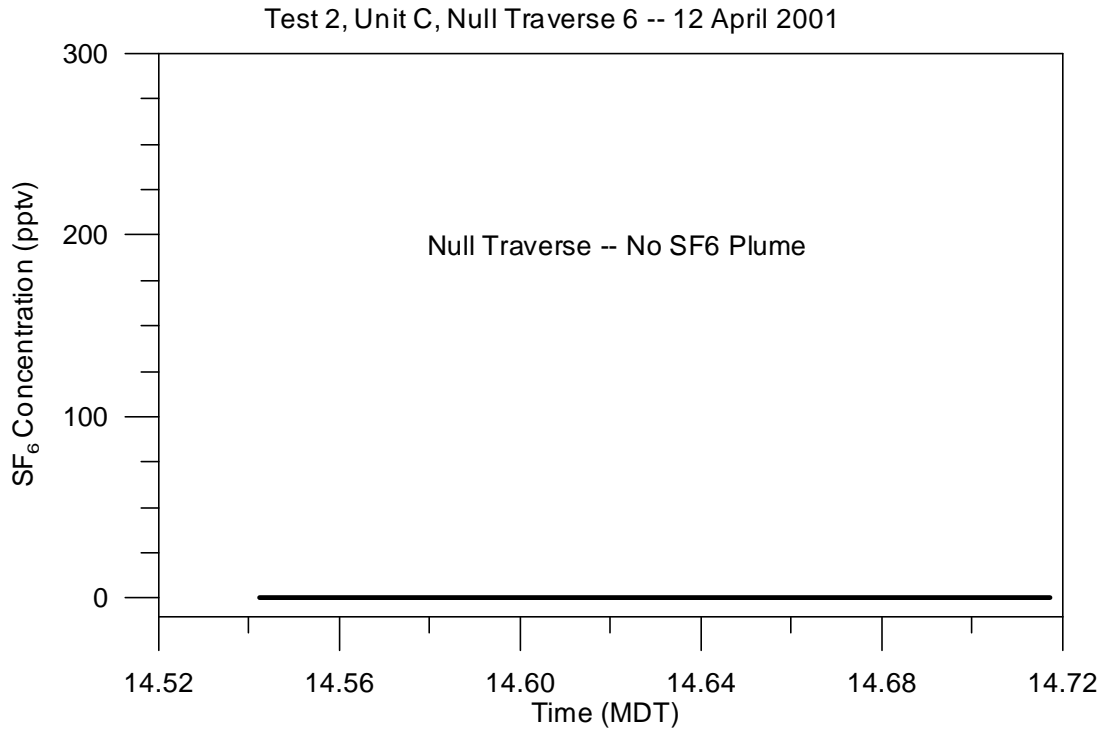


Figure A-71. Null sampling traverse 6 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

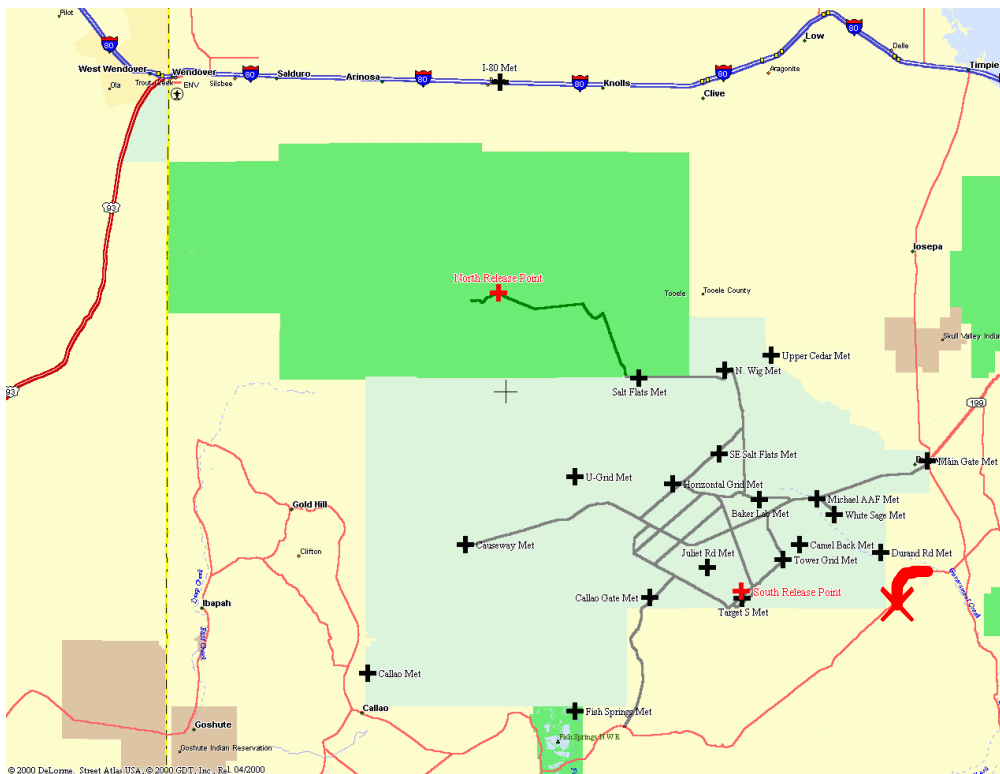
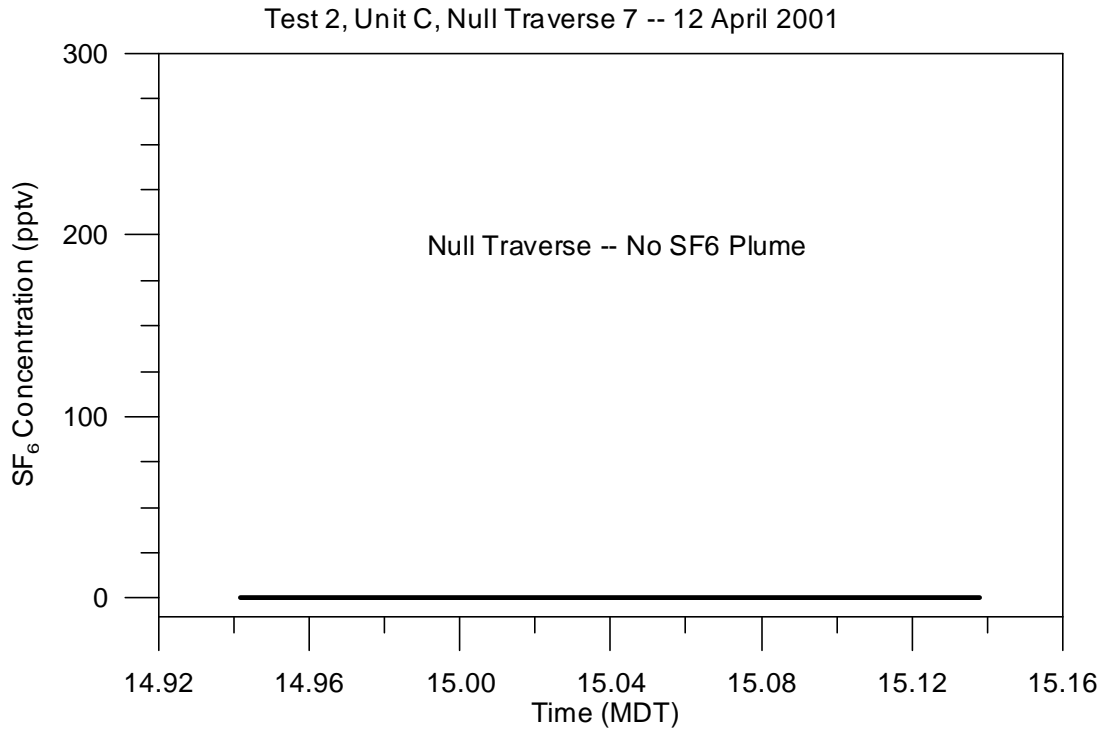


Figure A-72. Null sampling traverse 7 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

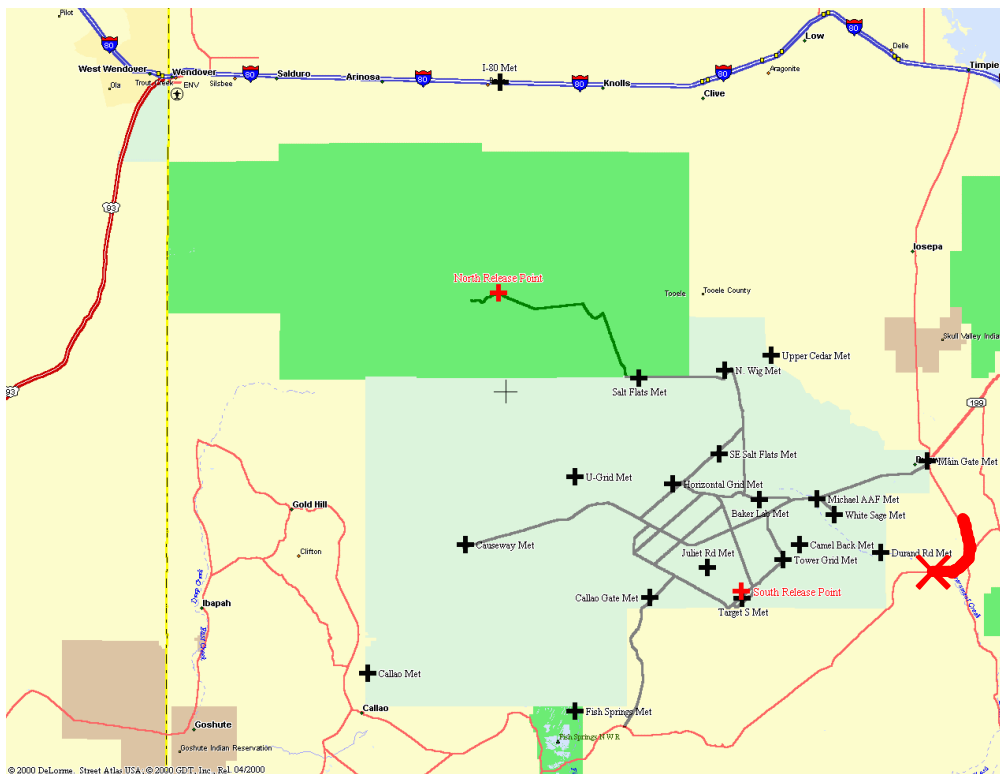
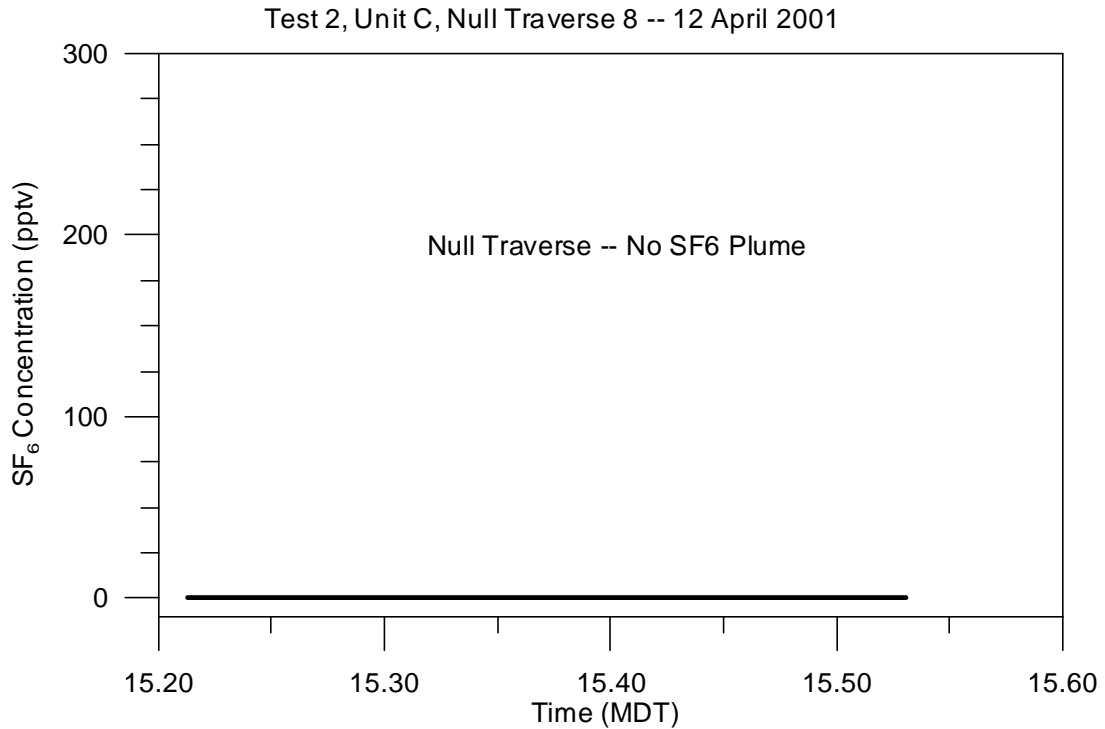


Figure A-73. Null sampling traverse 8 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

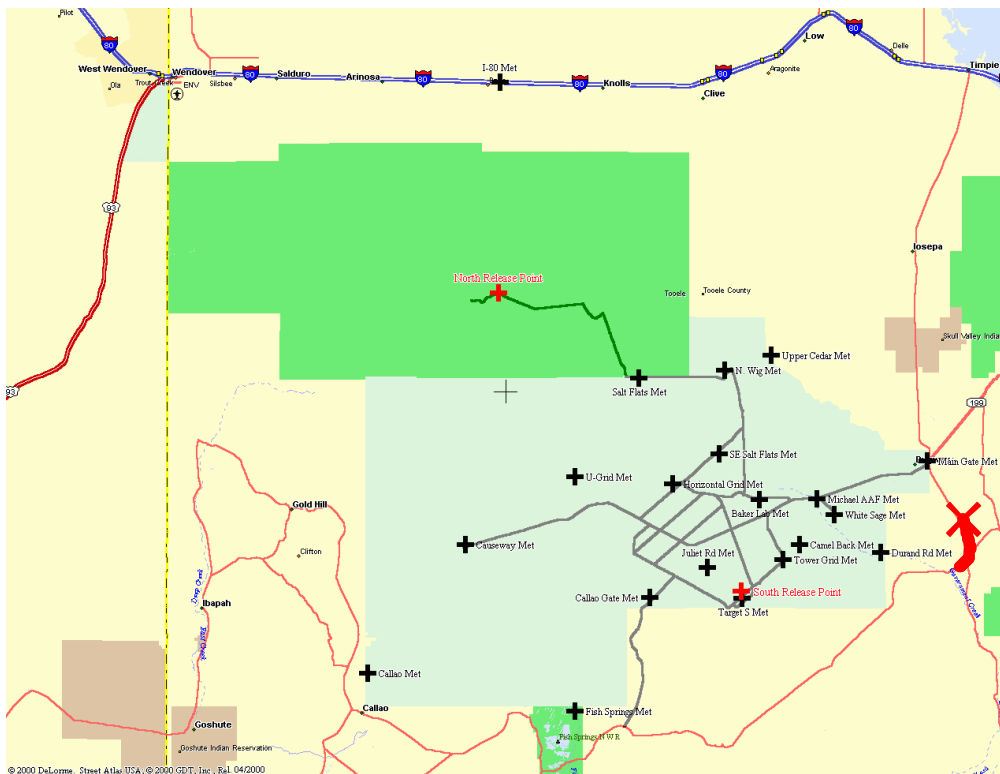
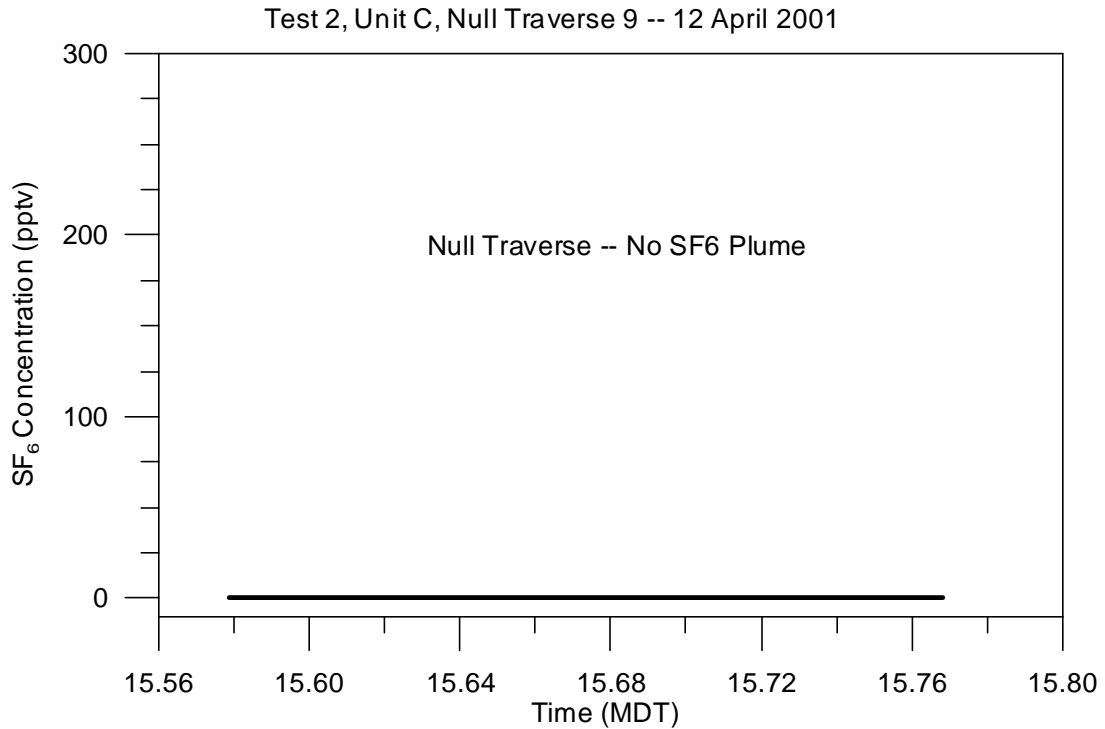


Figure A-74. Null sampling traverse 9 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

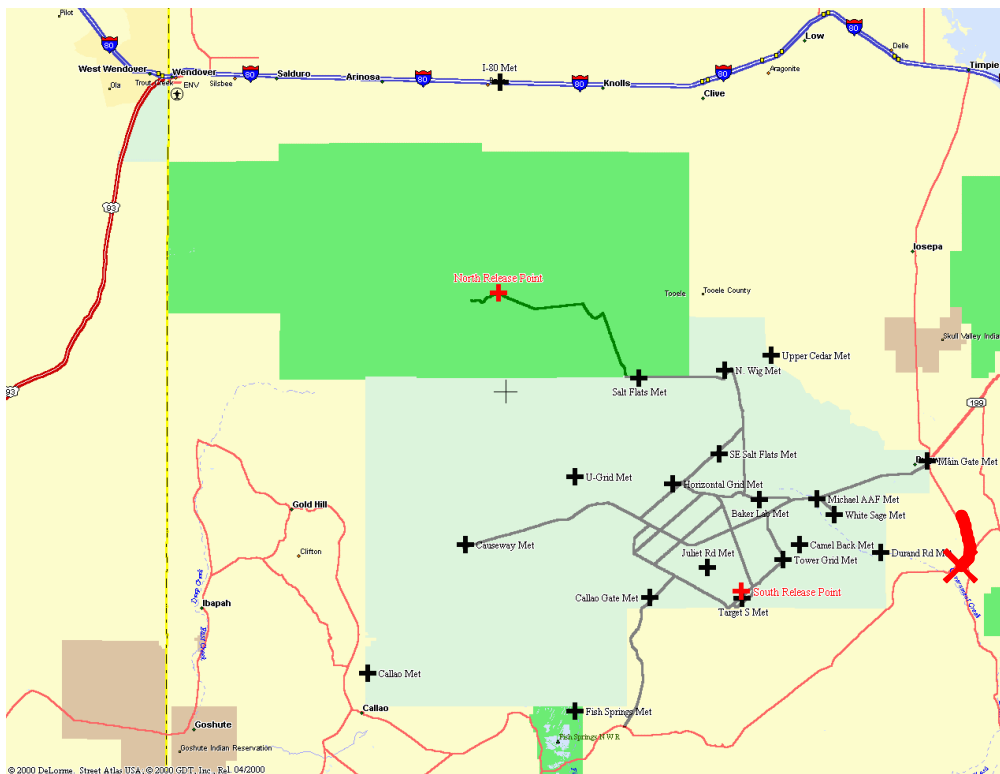
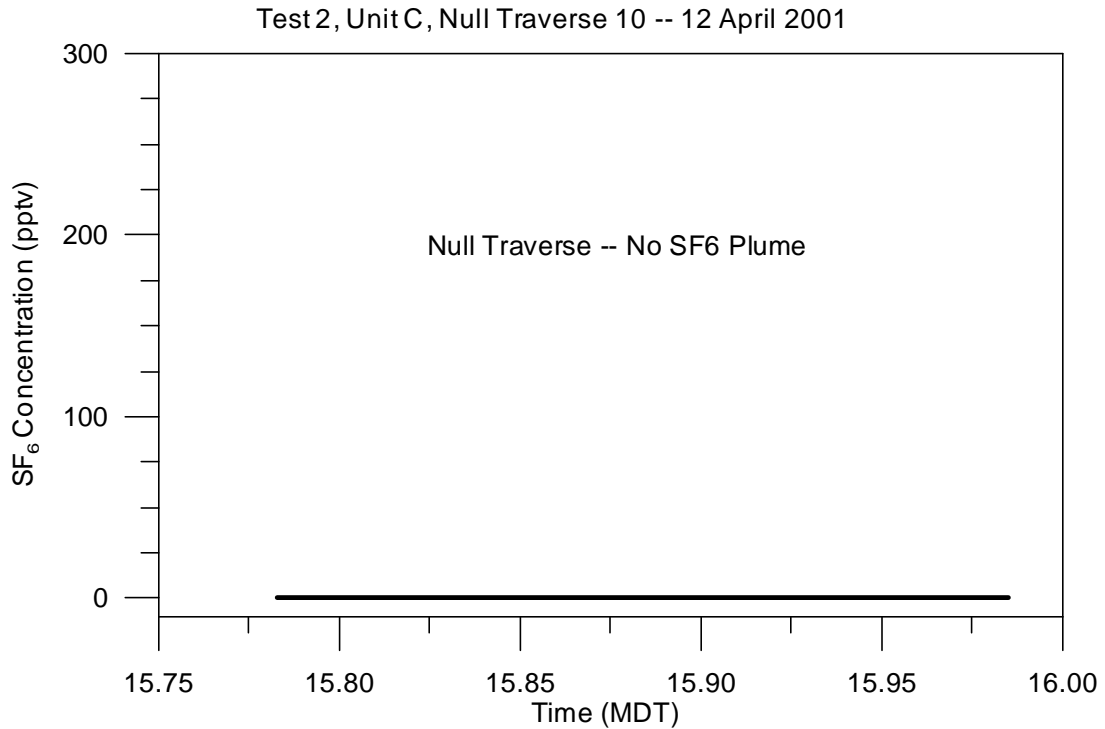


Figure A-75. Null sampling traverse 10 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

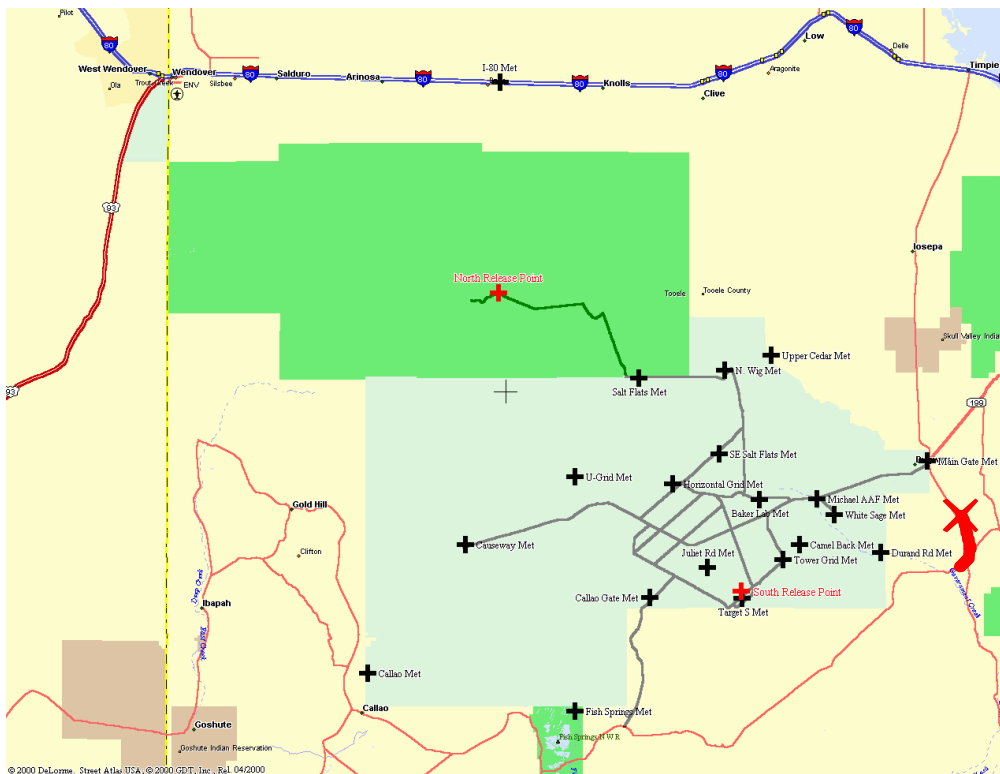
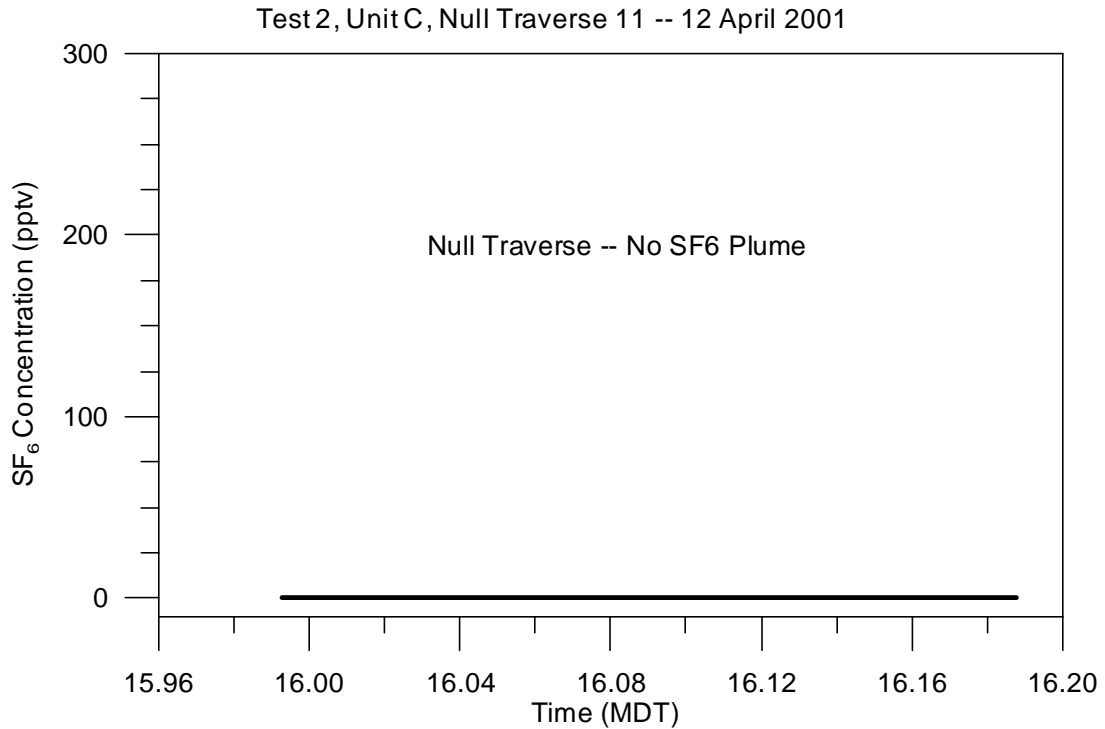


Figure A-76. Null sampling traverse 11 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

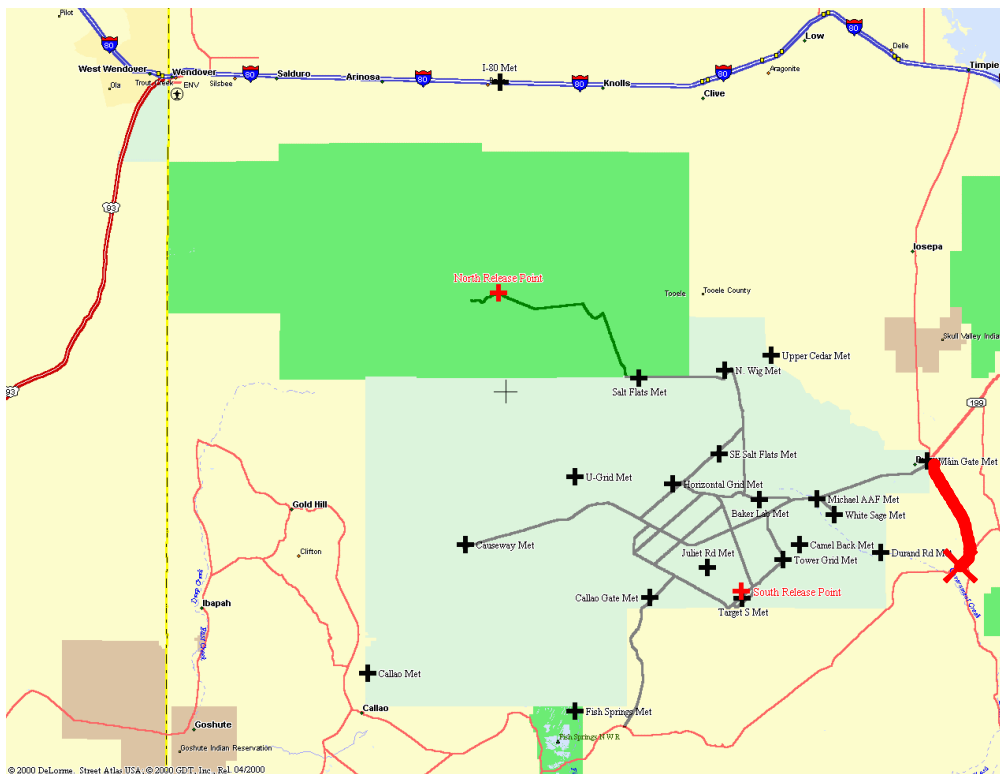
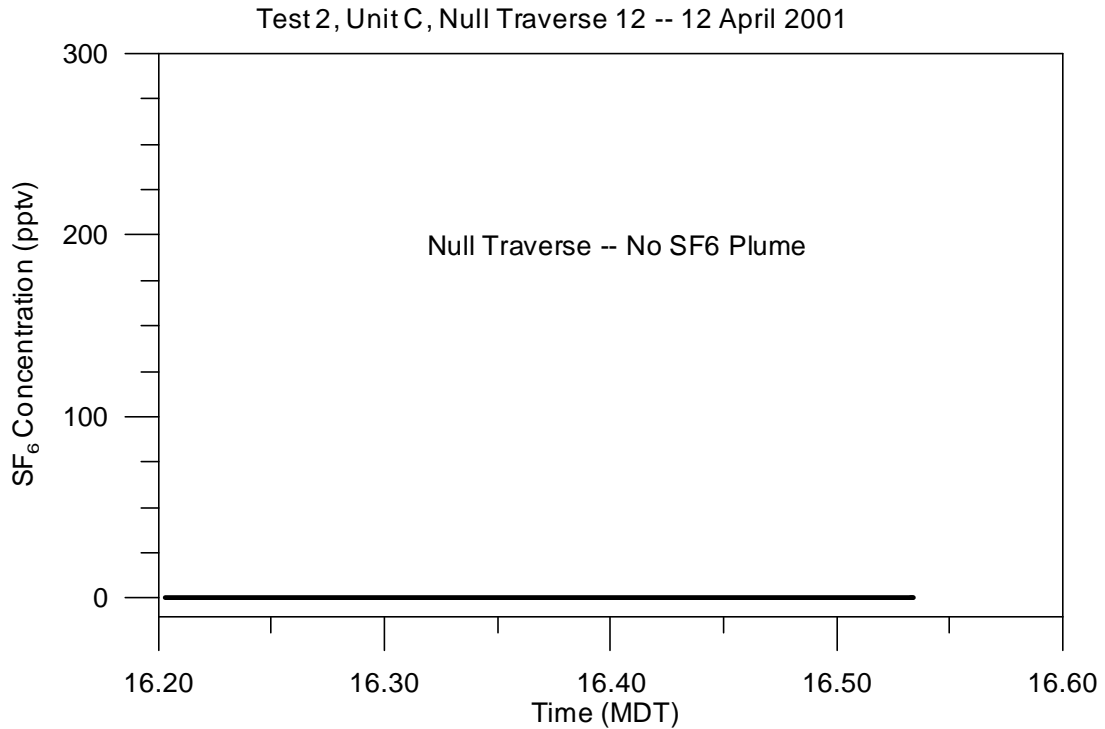


Figure A-77. Null sampling traverse 12 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

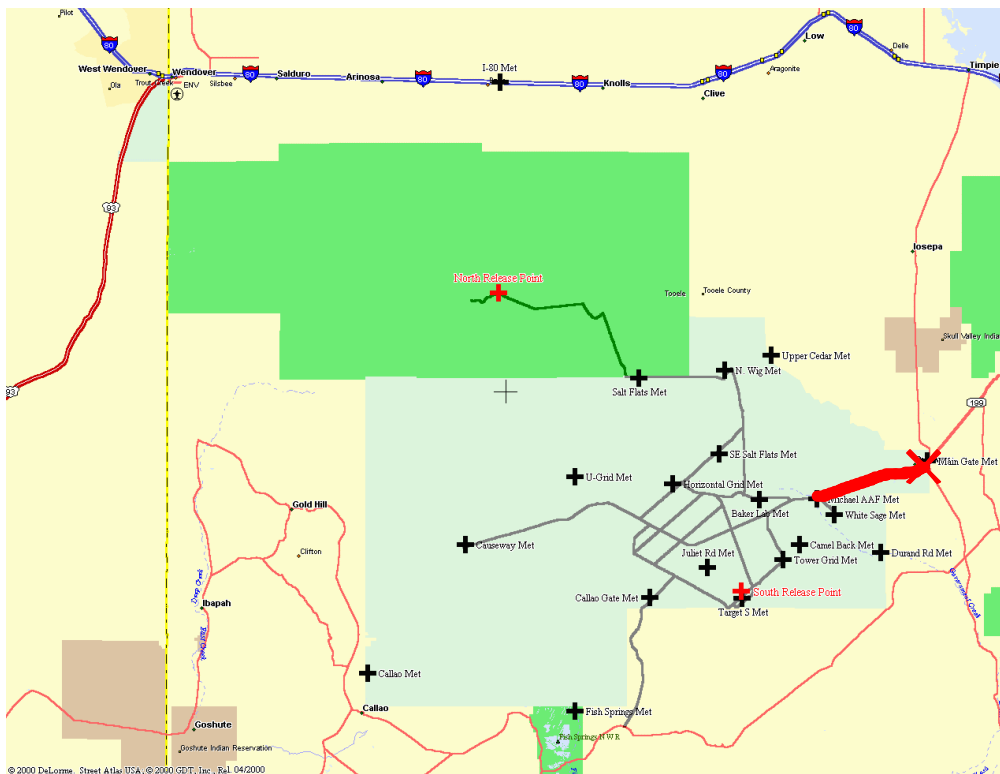
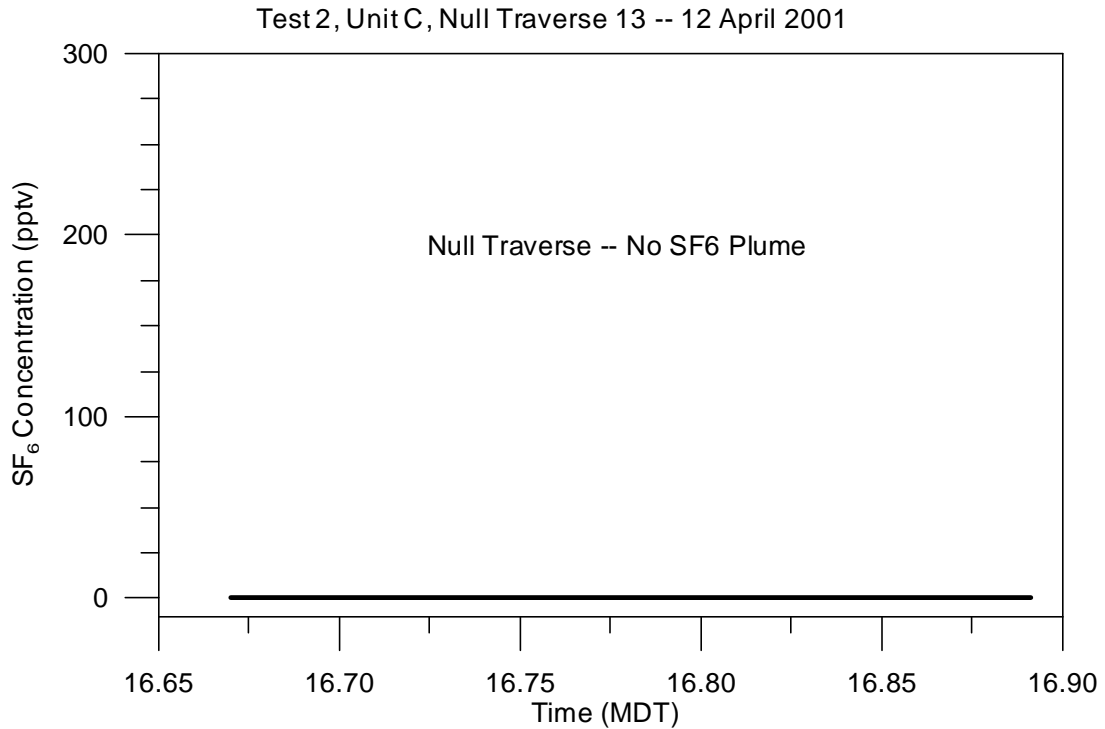


Figure A-78. Null sampling traverse 13 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

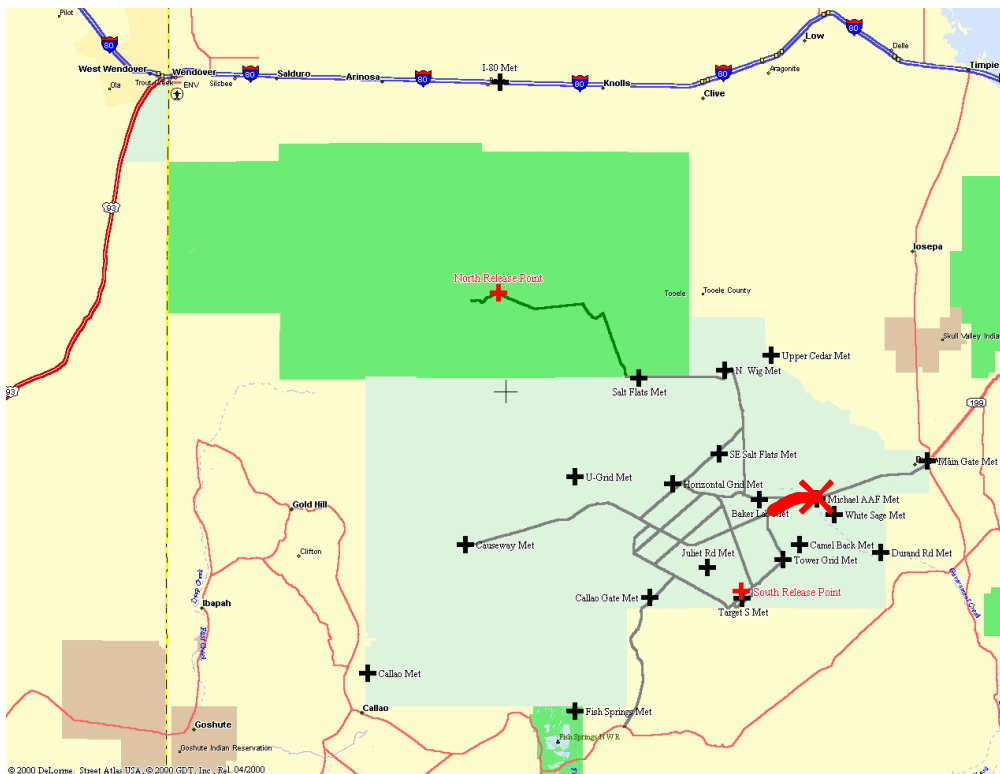
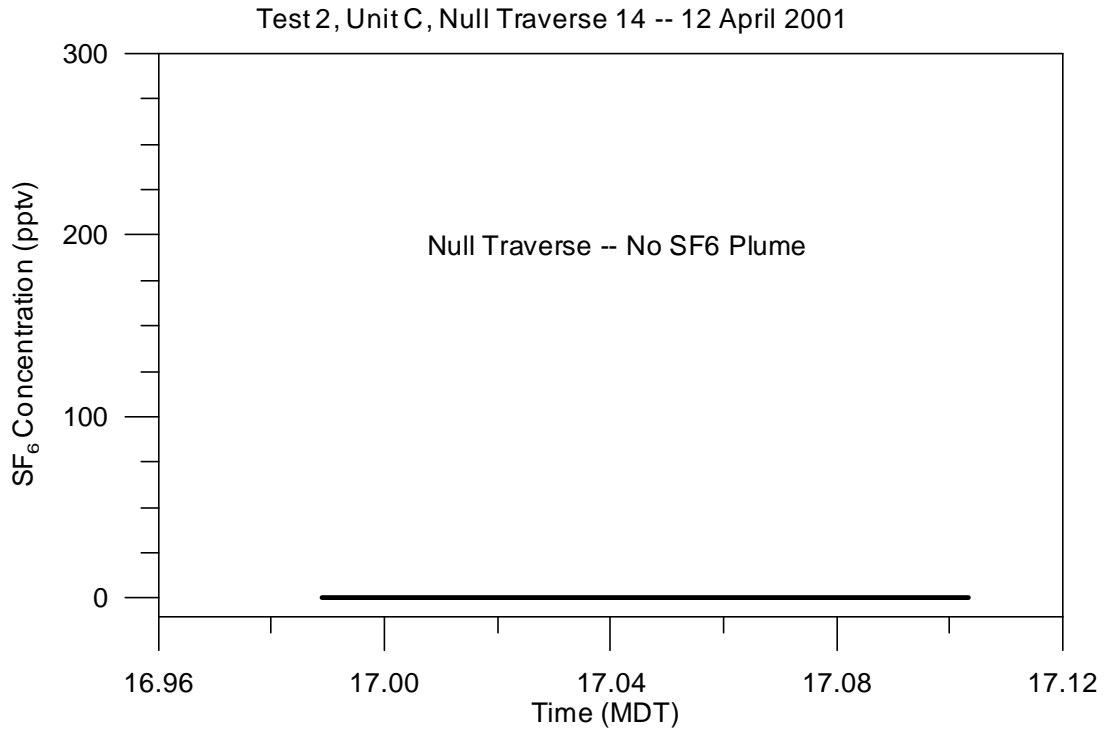


Figure A-79. Null sampling traverse 14 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

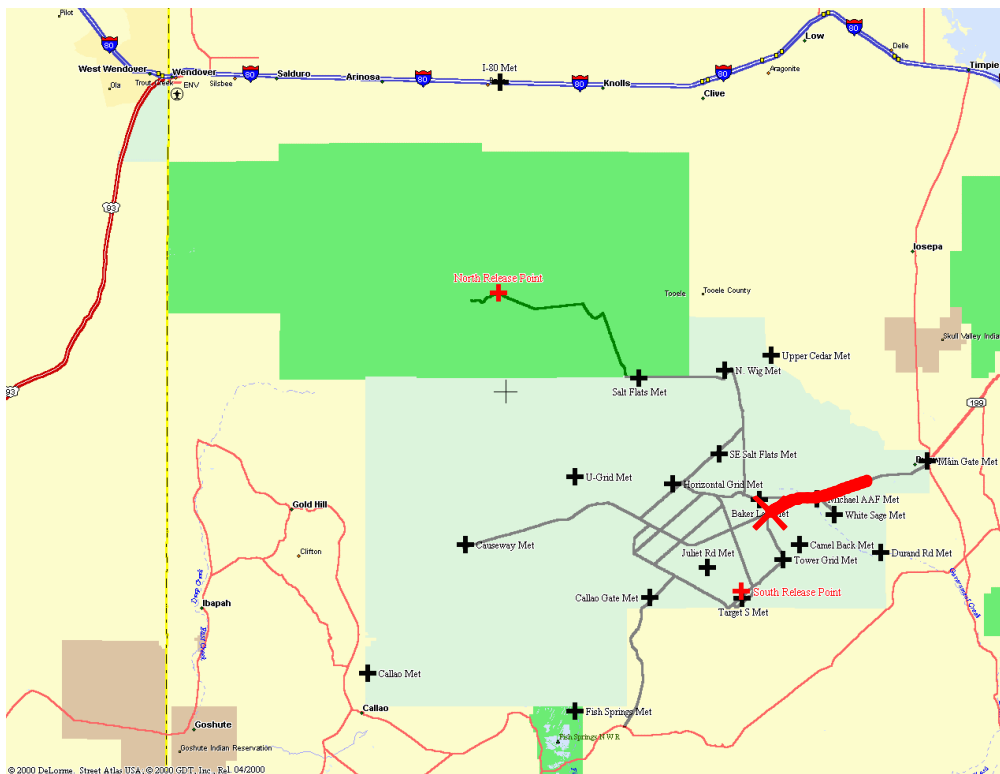
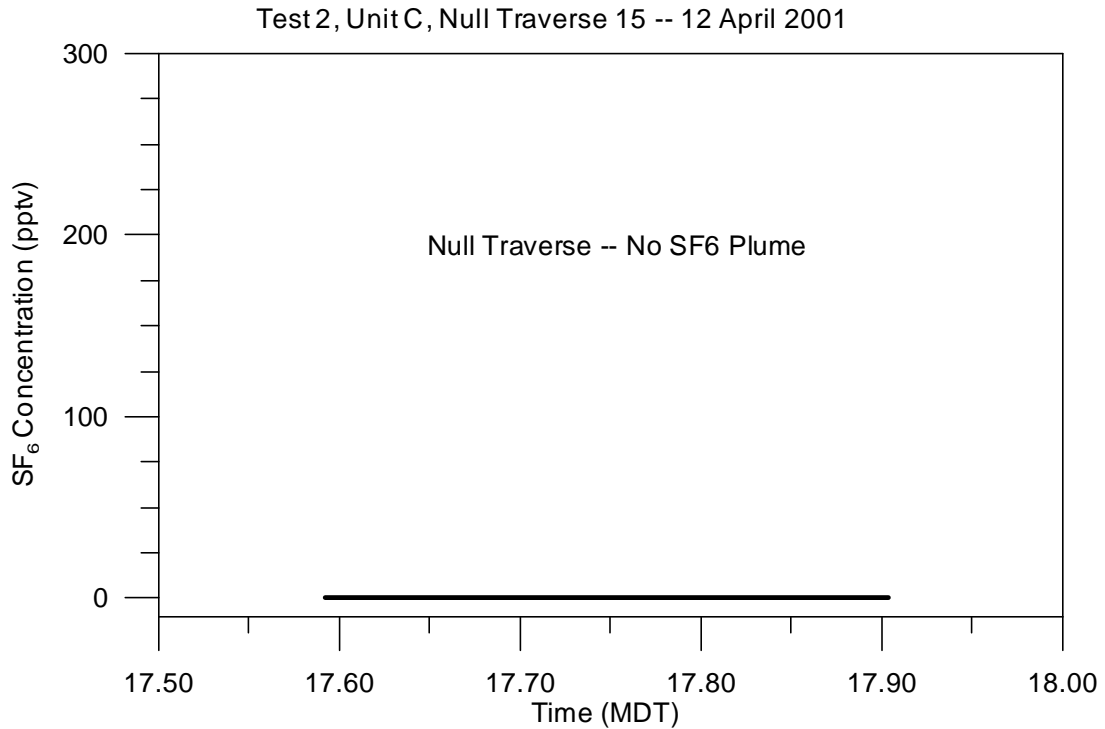


Figure A-80. Null sampling traverse 15 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

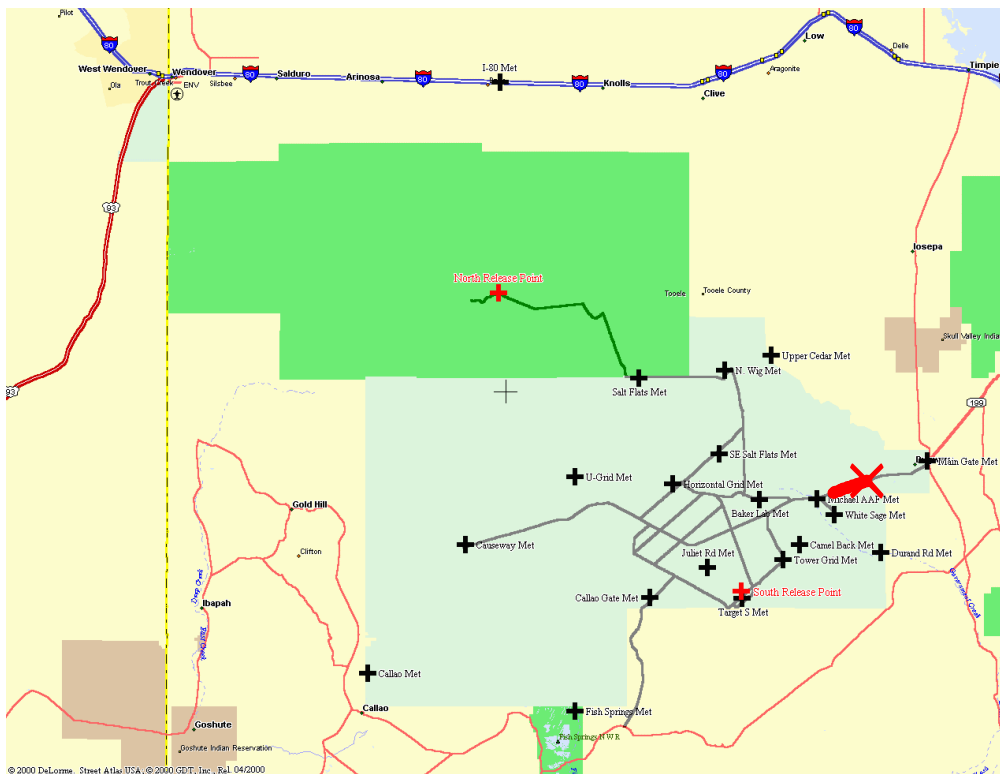
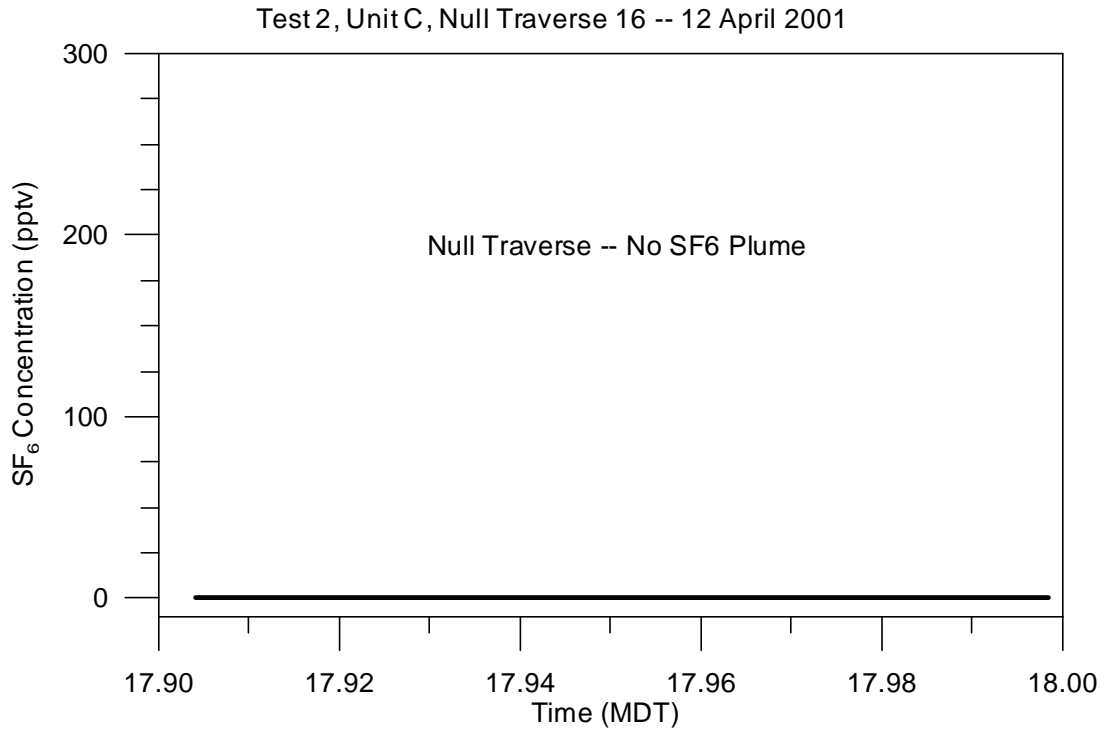


Figure A-81. Null sampling traverse 16 made by Sampling Unit C during Test 2, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 3 Sampling Unit A

Table A-22. Test 3 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	0:59	1:35

Table A-23. Summary of individual SF₆ plume characteristics measured by Sampling Unit A during Test 3. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	1:46-1:52	701	311.0-323.1	14.65	14.70	14.81
2	1:59-2:07	1021	302.6-327.1	14.65	14.86	15.30
3	2:13-2:23	1249	302.5-336.6	14.66	14.90	15.34
4	2:28-2:41	1496	298.8-337.8	14.65	15.01	15.65
5	2:47-2:59	1436	298.1-338.1	14.65	15.04	15.73
6	3:02-3:14	1536	330.9-346.2	15.47	17.69	19.99
7	3:23-3:39	1812	307.9-346.4	17.86	18.51	20.03
8	3:45-4:03	2095	306.1-346.4	17.87	18.49	20.02
9	4:10-4:26	2000	311.2-346.4	17.86	18.47	20.02
10	4:27-4:50	2761	310.4-350.1	17.87	18.47	20.75
11	5:10-5:30	2401	305.2-350.6	17.86	18.58	20.85
12	5:34-5:57	2734	305.2-350.5	17.87	18.54	20.84
13	6:03-6:28	3000	305.2-354.9	17.86	18.78	21.90
14	6:30-6:56	3136	305.1-354.2	17.86	18.77	21.71
15	7:01-7:23	2584	305.2-353.9	17.87	18.77	21.63
16	7:27-7:51	2901	305.1-355.0	17.87	18.99	21.91
17	8:08-8:27	2288	0.8-39.8	13.83	16.51	21.70

Table A-24. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit A during Test 3.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	1146.2	1:50	40.155168	113.168533	316.9	14.67
2	3814.1	2:04	40.142487	113.187737	308.6	14.91
3	3140.5	2:20	40.163672	113.155700	322.6	14.68
4	2782.9	2:31	40.172112	113.142803	328.2	14.83
5	3799.4*	2:54	40.160788	113.159998	320.7	14.66
6	2915.7	3:07	40.202082	113.155022	330.9	18.22
7	4298.9*	3:32	40.193045	113.168818	326.1	17.98
8	6676.7	3:58	40.212278	113.139550	336.1	18.65
9	6714.5	4:14	40.217688	113.131195	338.8	18.93
10	6626.3	4:46	40.222833	113.123398	341.3	19.24
11	6542.4	5:14	40.224215	113.121273	342.0	19.33
12	6356.3	5:53	40.224385	113.121080	342.0	19.34
13	6034.0	6:08	40.231120	113.110710	345.1	19.81
14	5196.7	6:49	40.212783	113.138742	336.4	18.67
15	4787.2	7:09	40.212138	113.139738	336.1	18.64
16	3618.2	7:43	40.217108	113.132148	338.5	18.90
17	250.5	8:22	40.179350	112.964968	28.8	15.28

*Analyzer over-ranged during this traverse, resulting in a flat-topped peak and an unknown maximum concentration.

No null passes were made by Sampling Unit A either during or after the time period of active plume sampling listed in the previous two tables.

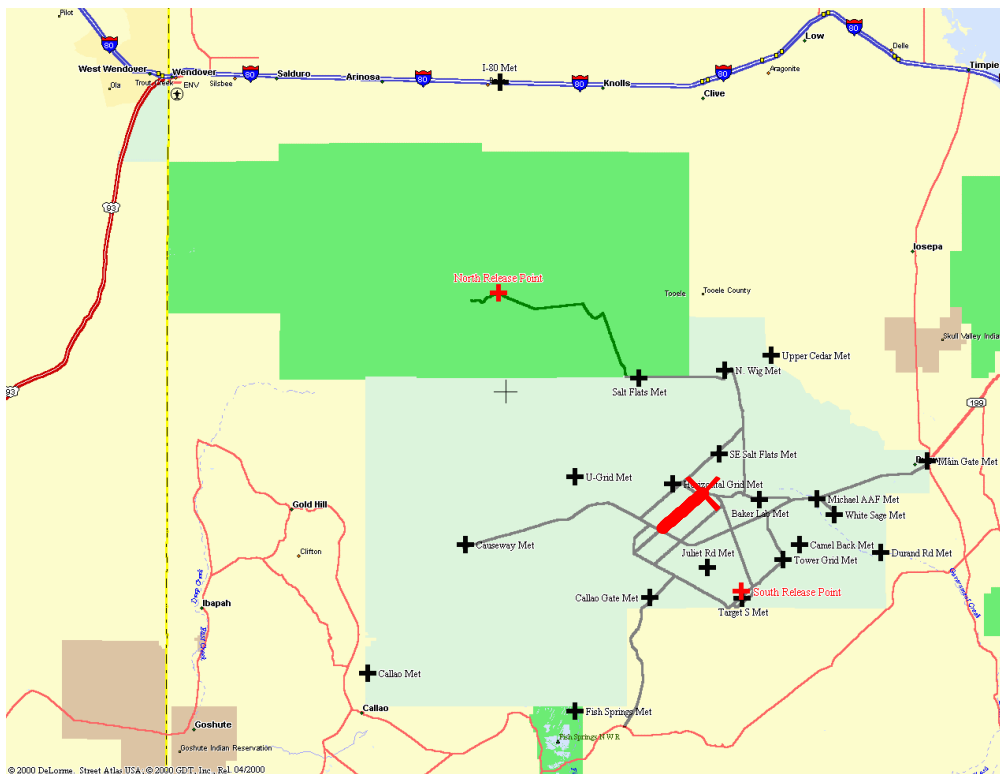
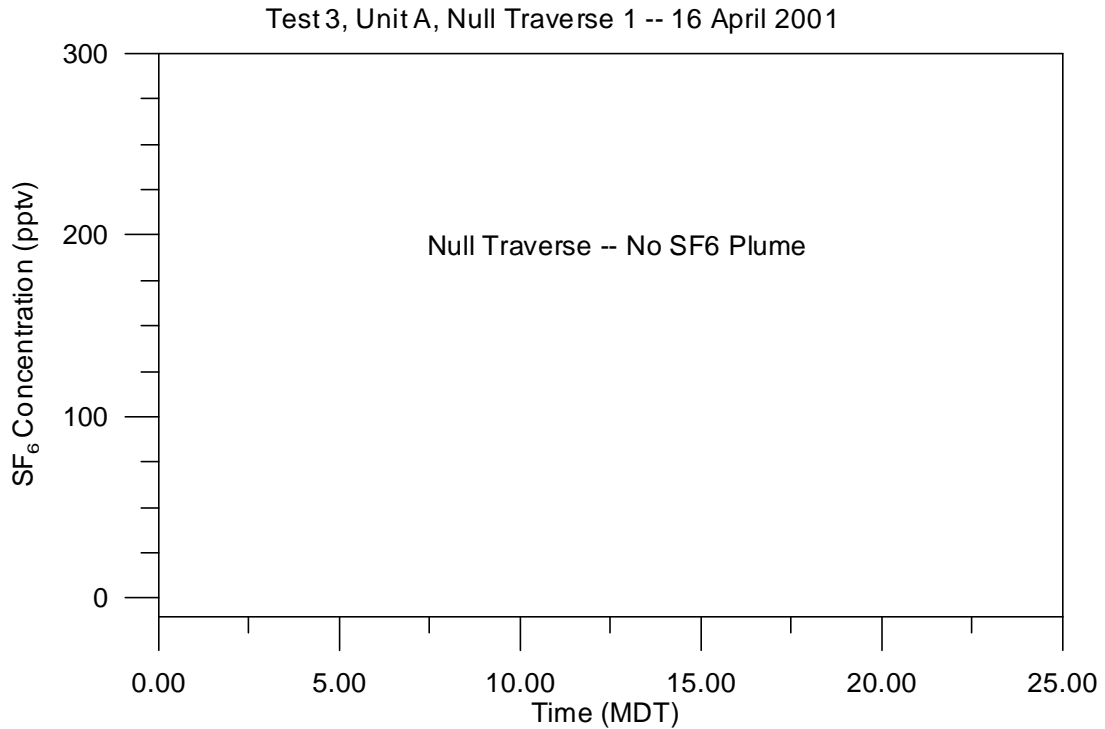


Figure A-82. Null sampling traverse 1 made by Sampling Unit A during Test 3, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

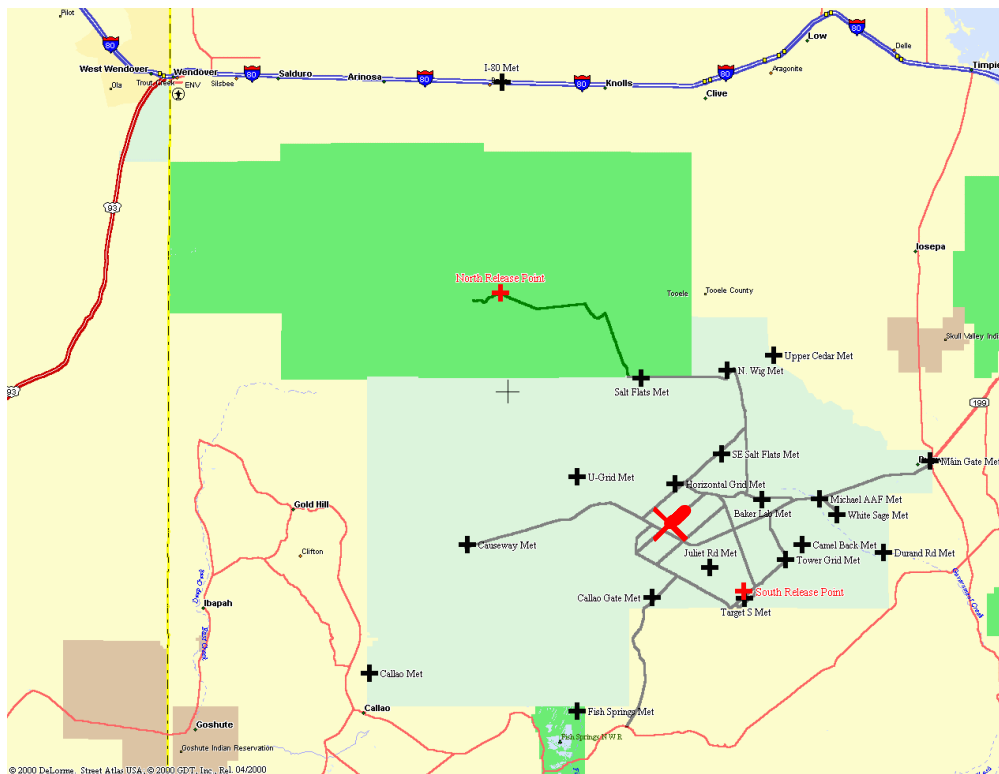
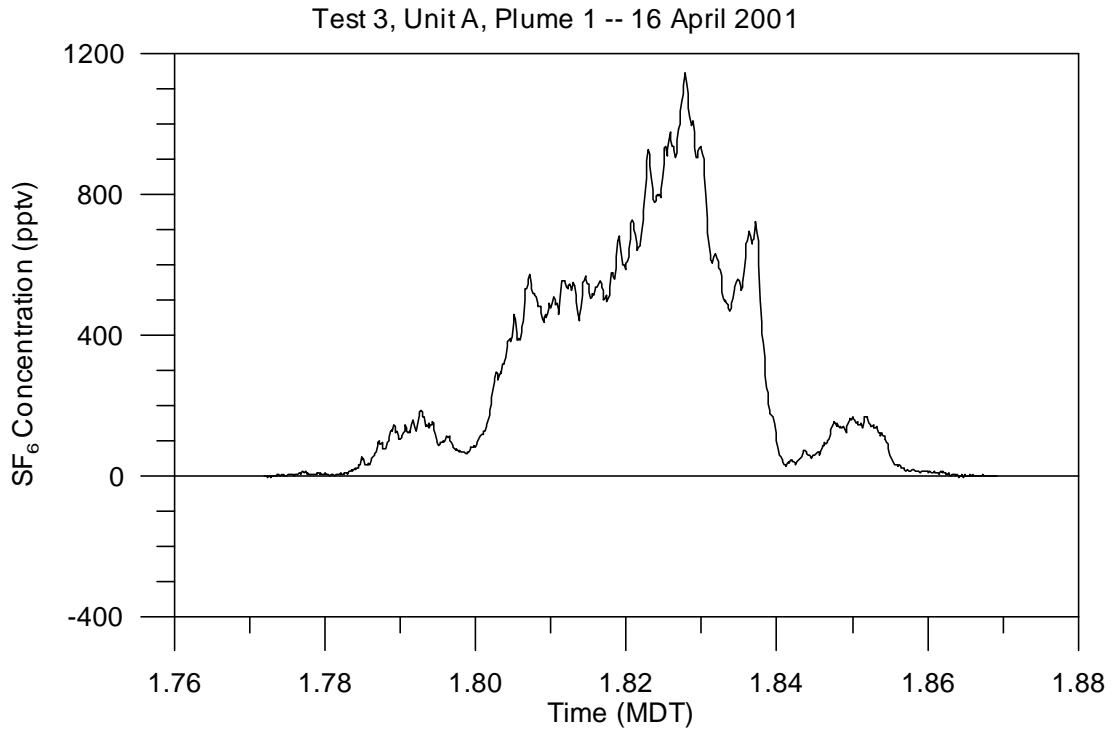


Figure A-83. SF₆ concentration of Plume 1 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

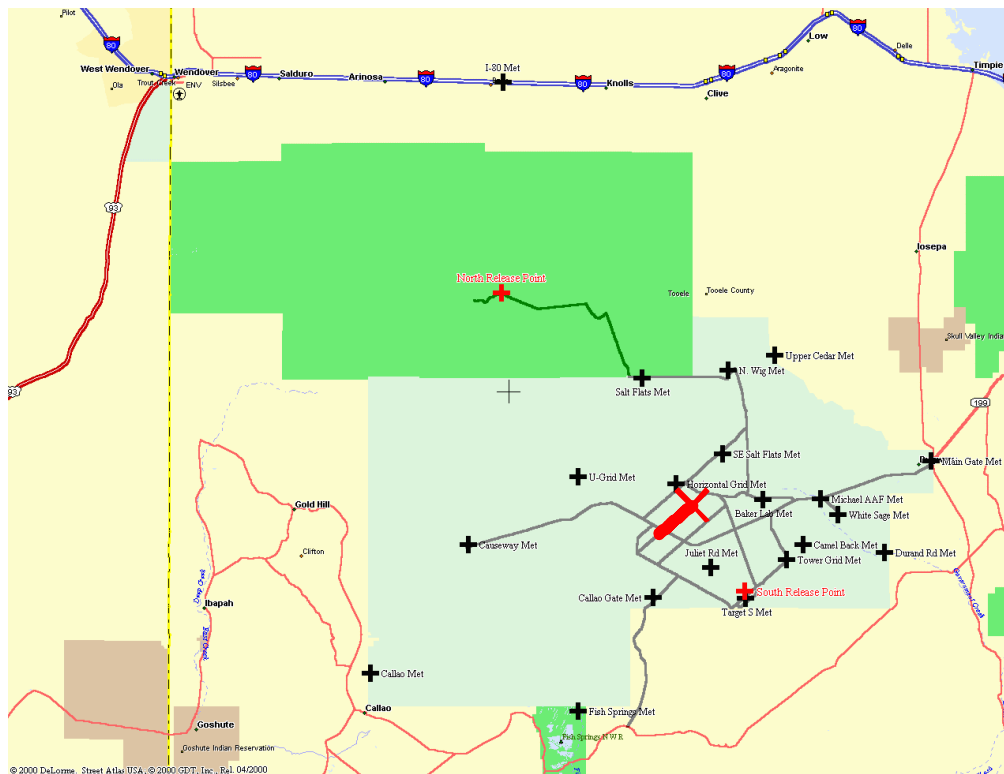
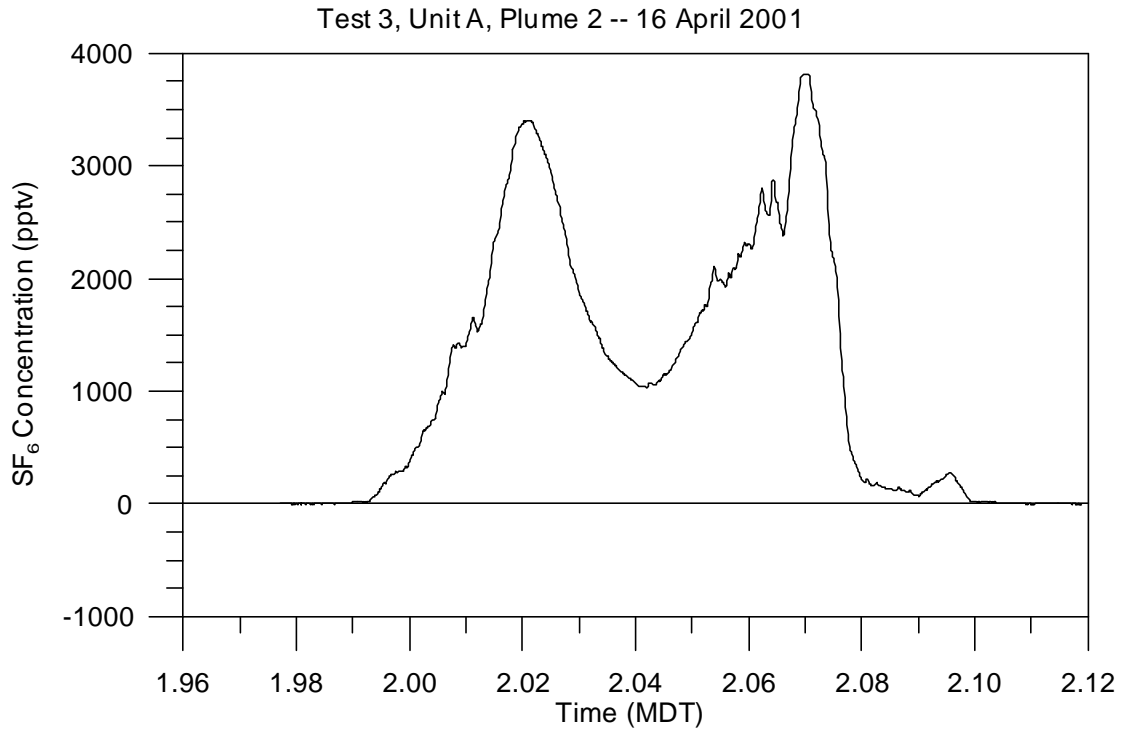


Figure A-84. SF₆ concentration of Plume 2 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

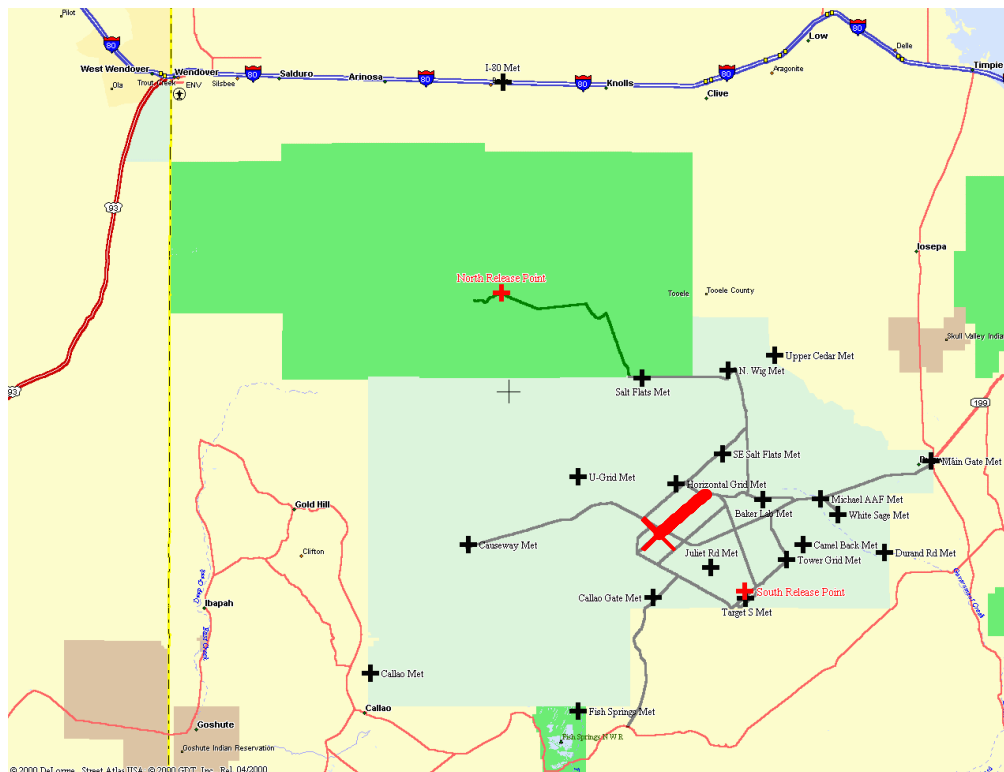
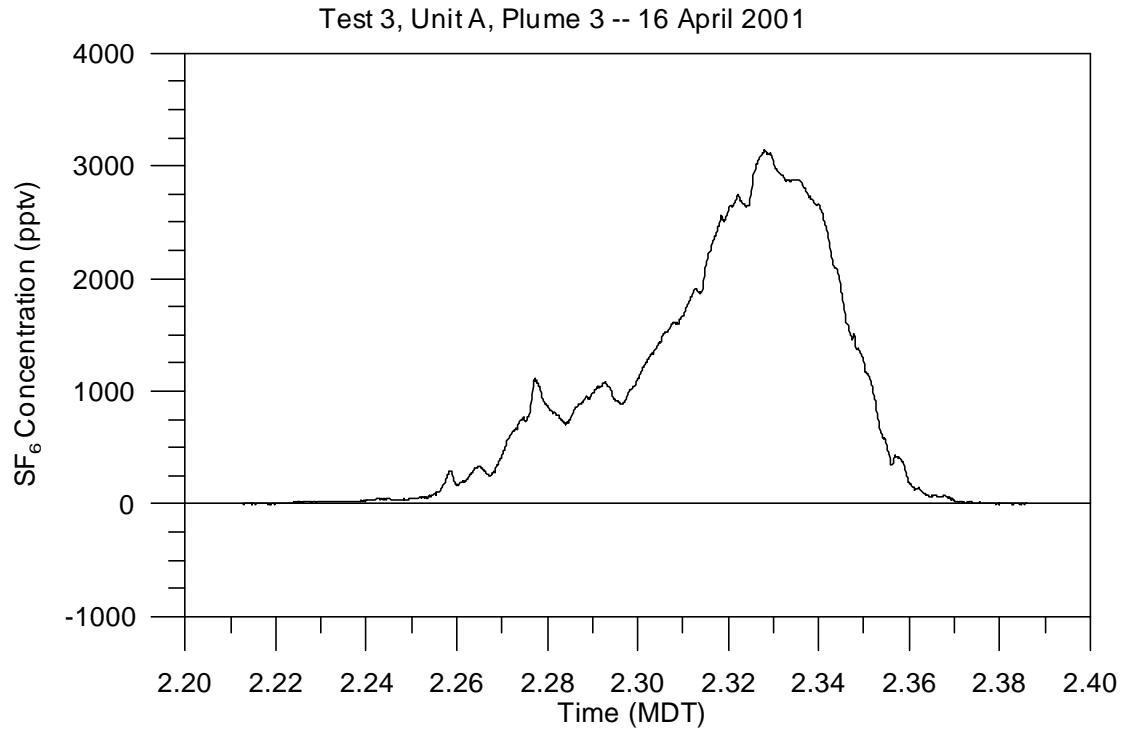


Figure A-85. SF₆ concentration of Plume 3 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

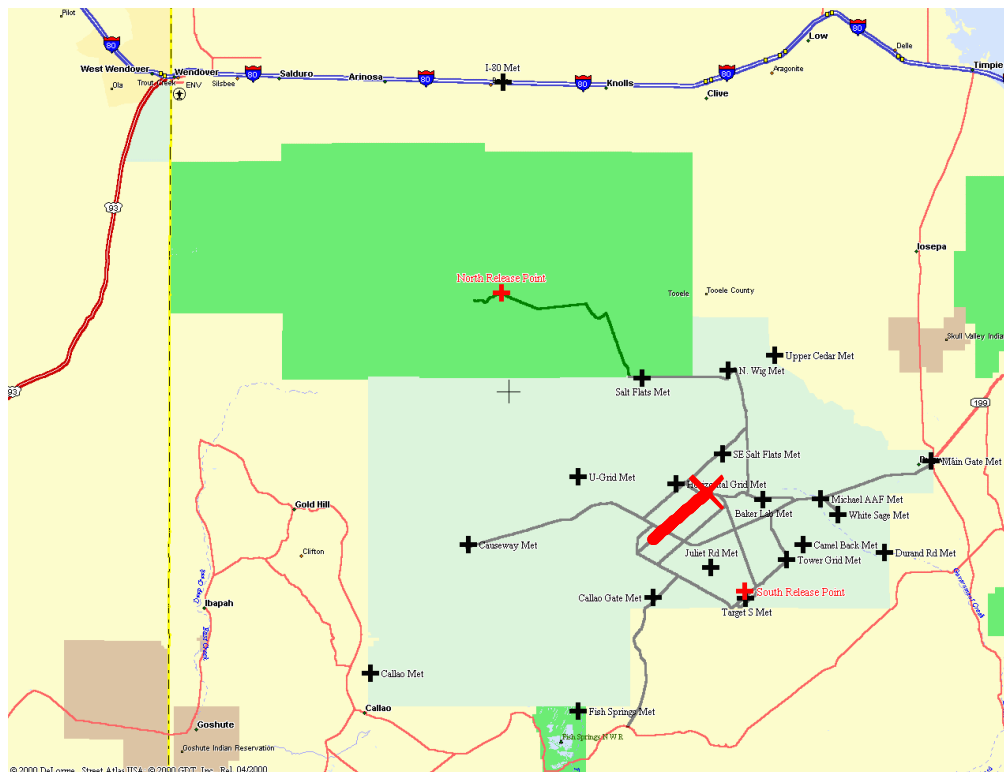
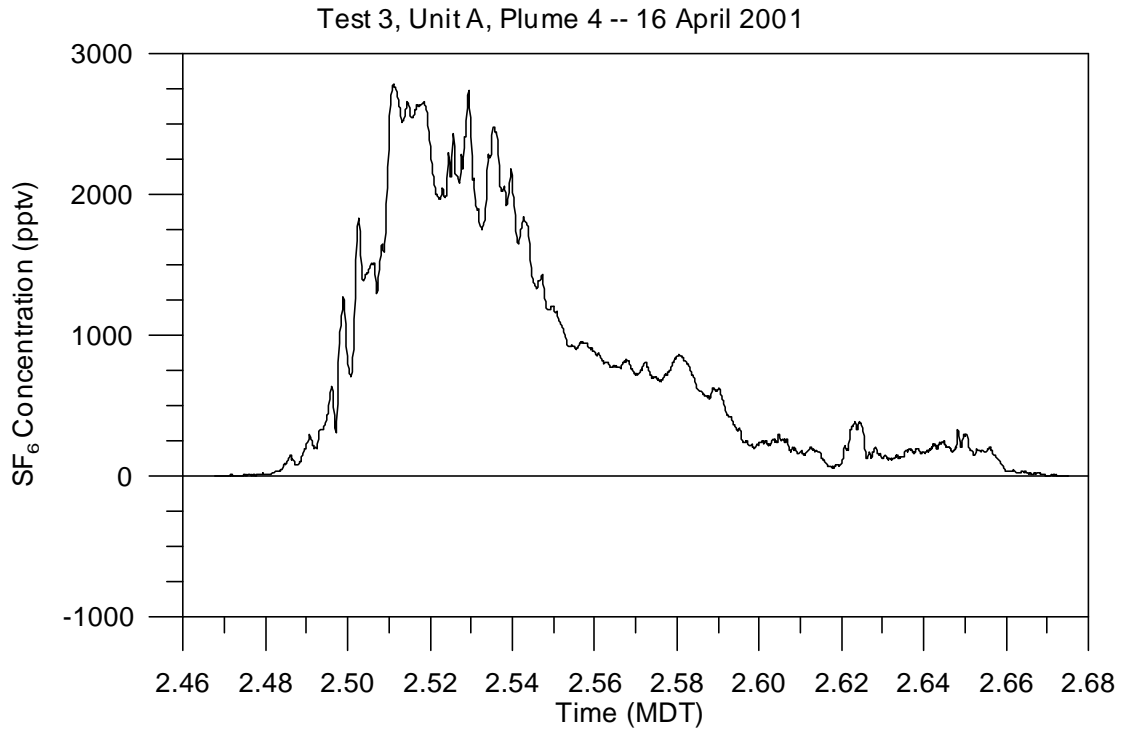


Figure A-86. SF₆ concentration of Plume 4 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

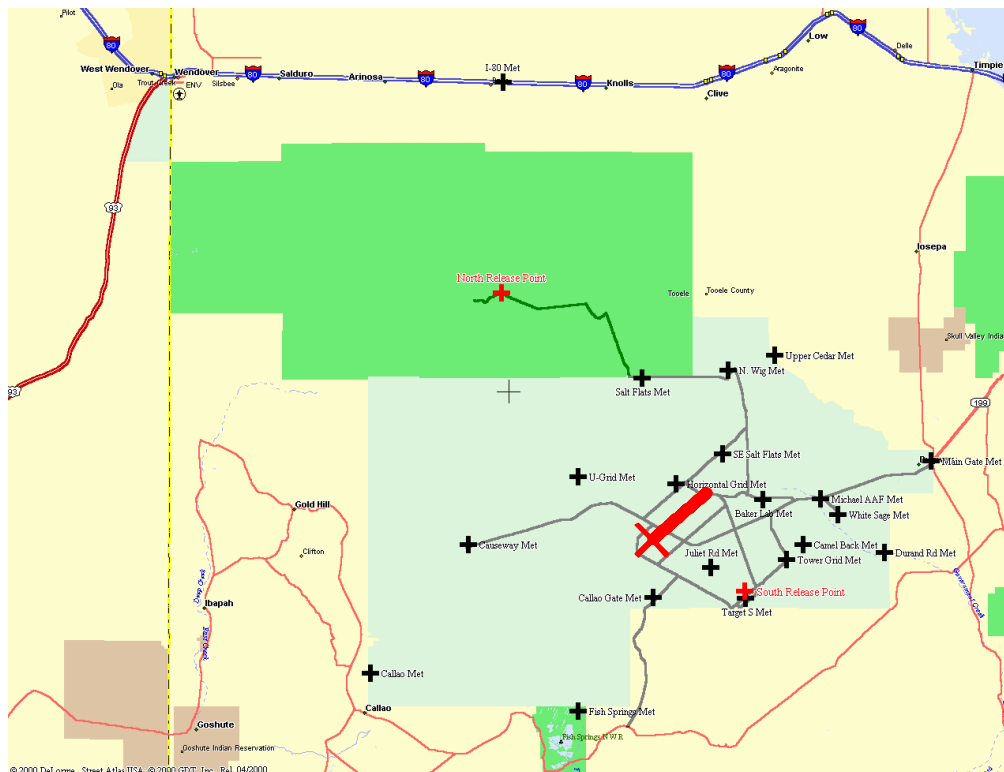
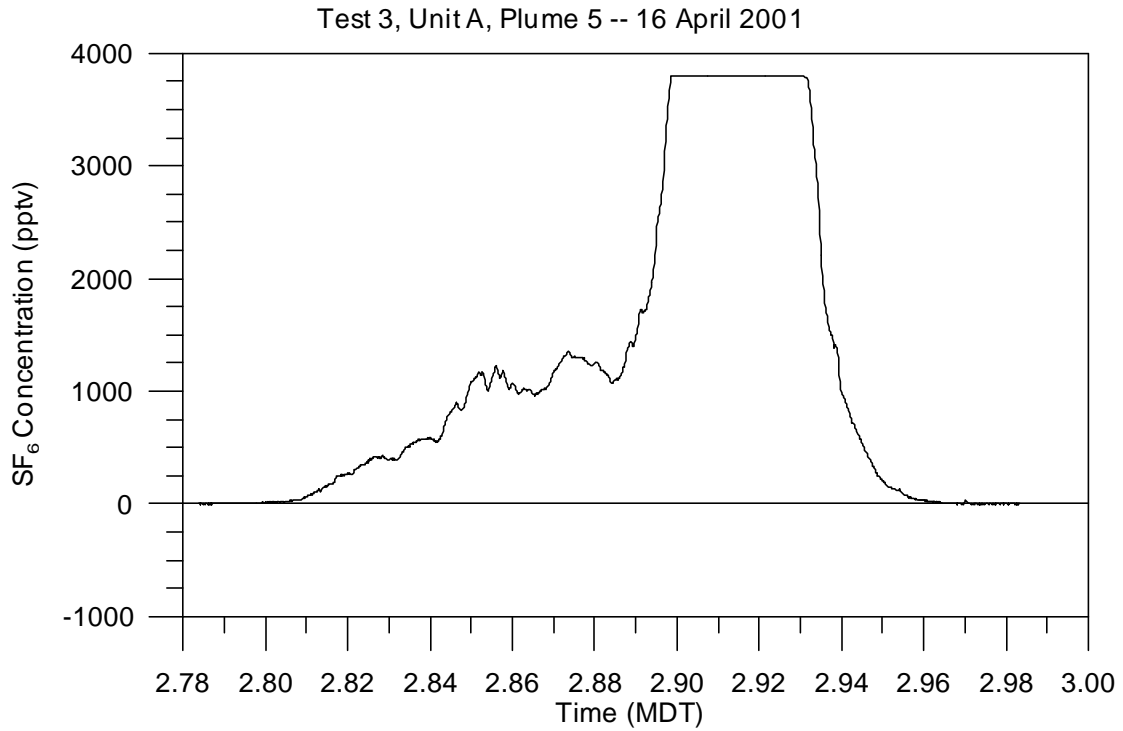


Figure A-87. SF₆ concentration of Plume 5 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

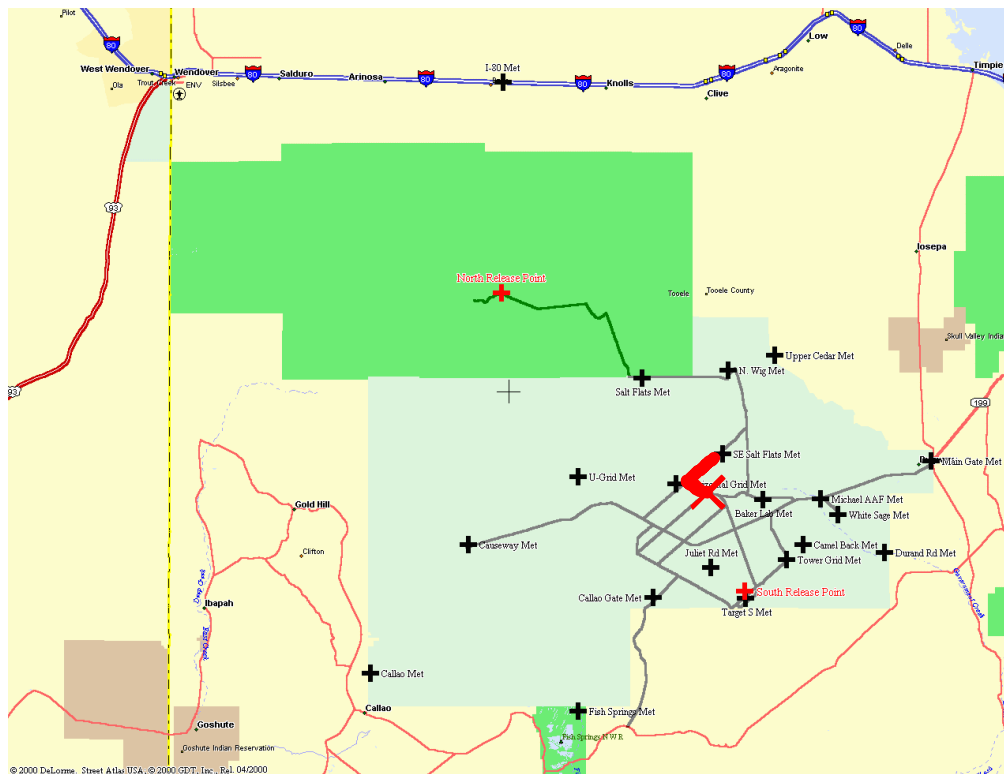
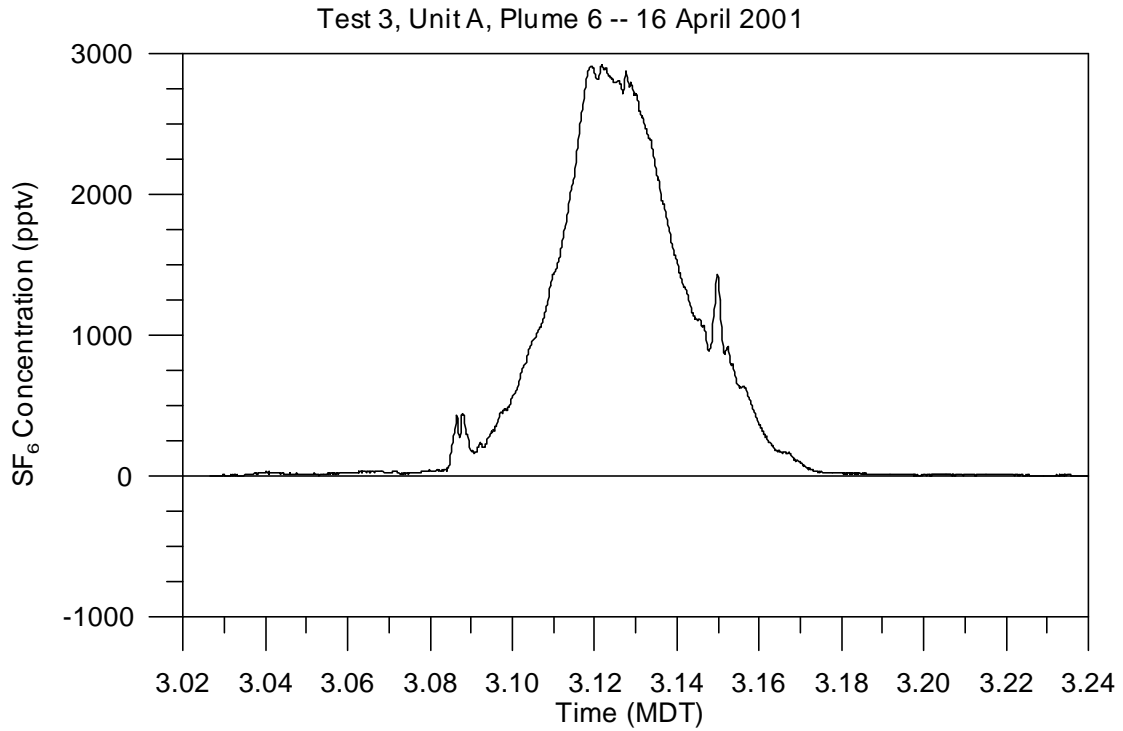


Figure A-88. SF₆ concentration of Plume 6 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

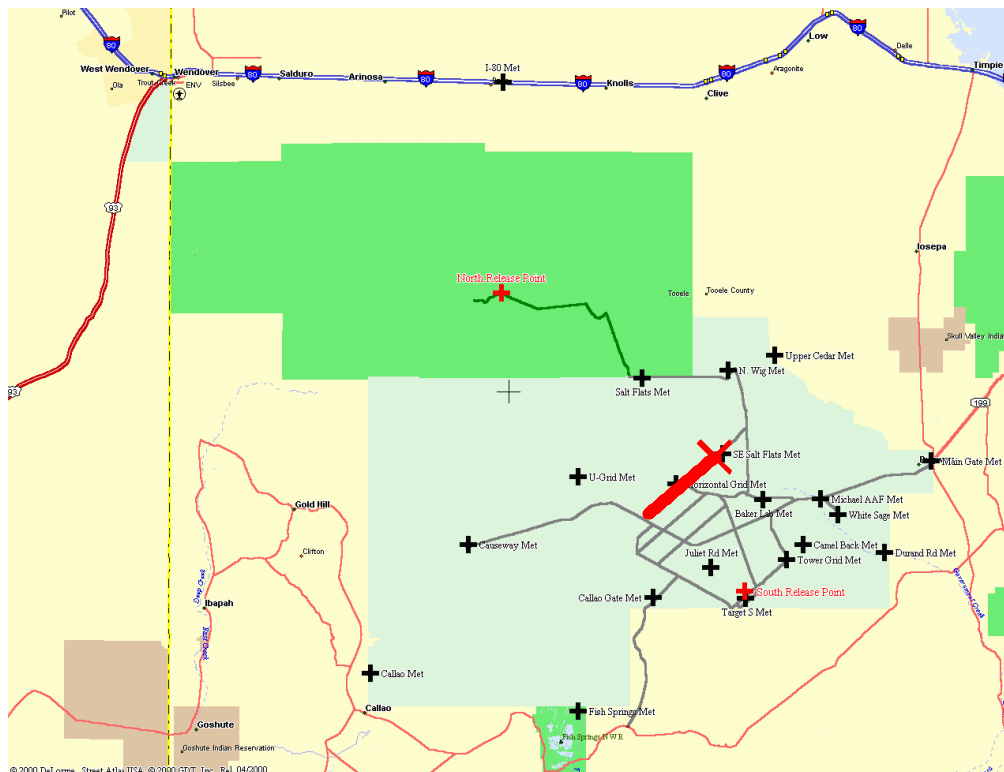
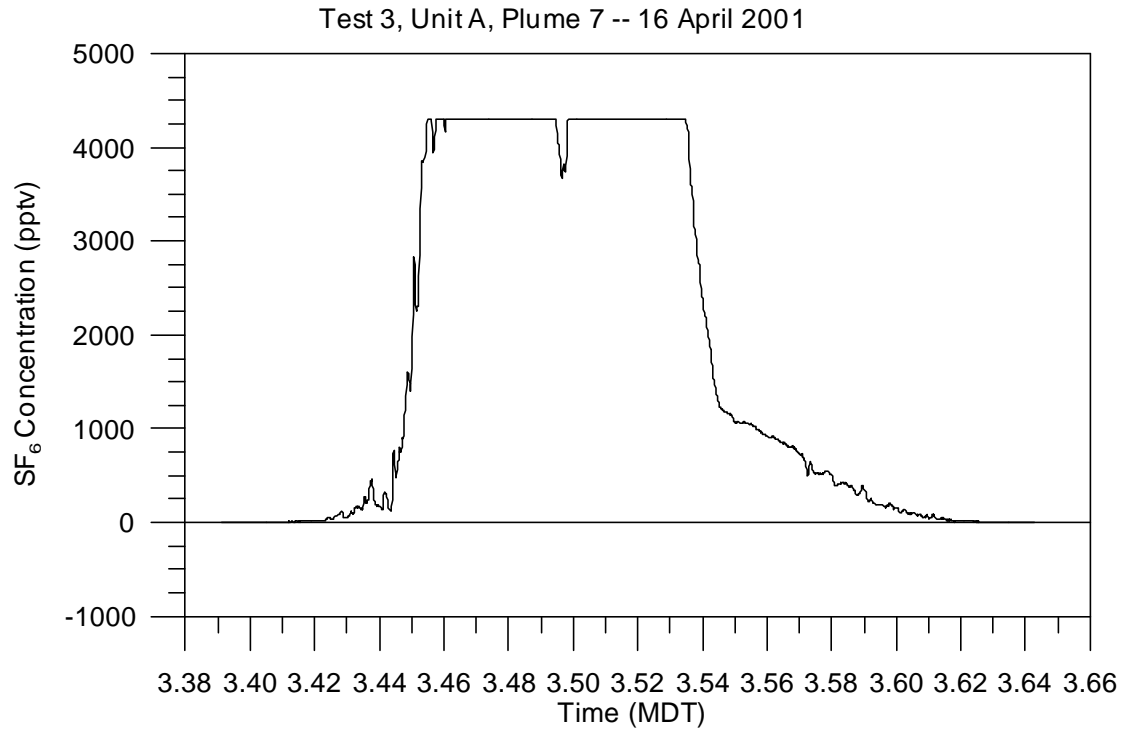


Figure A-89. SF₆ concentration of Plume 7 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

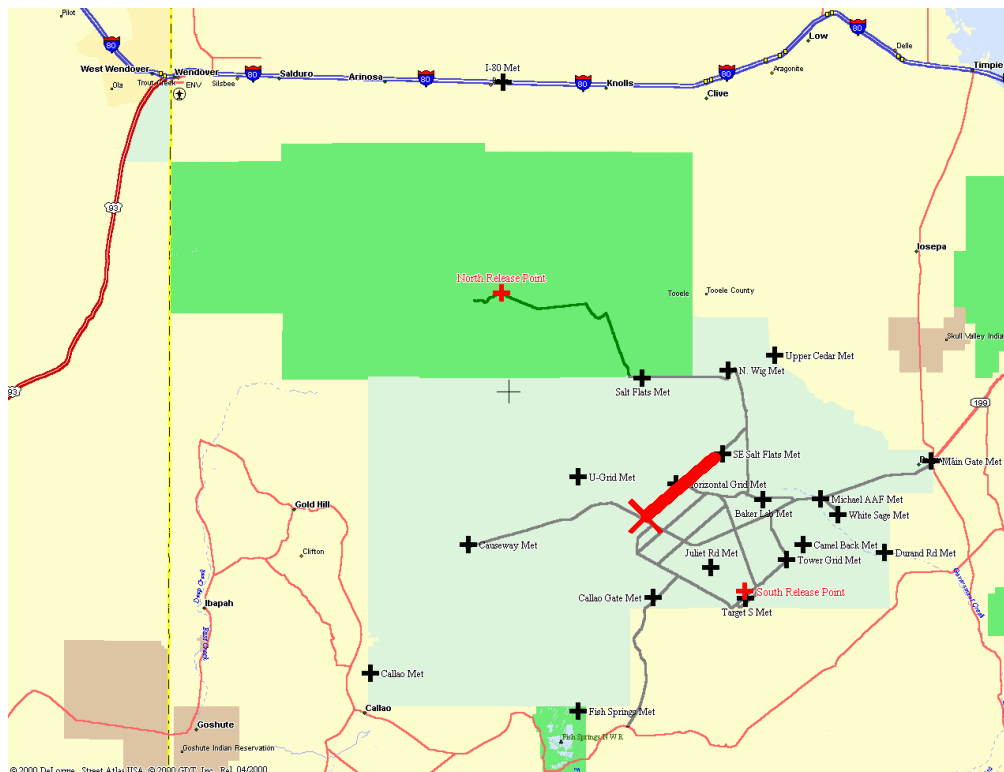
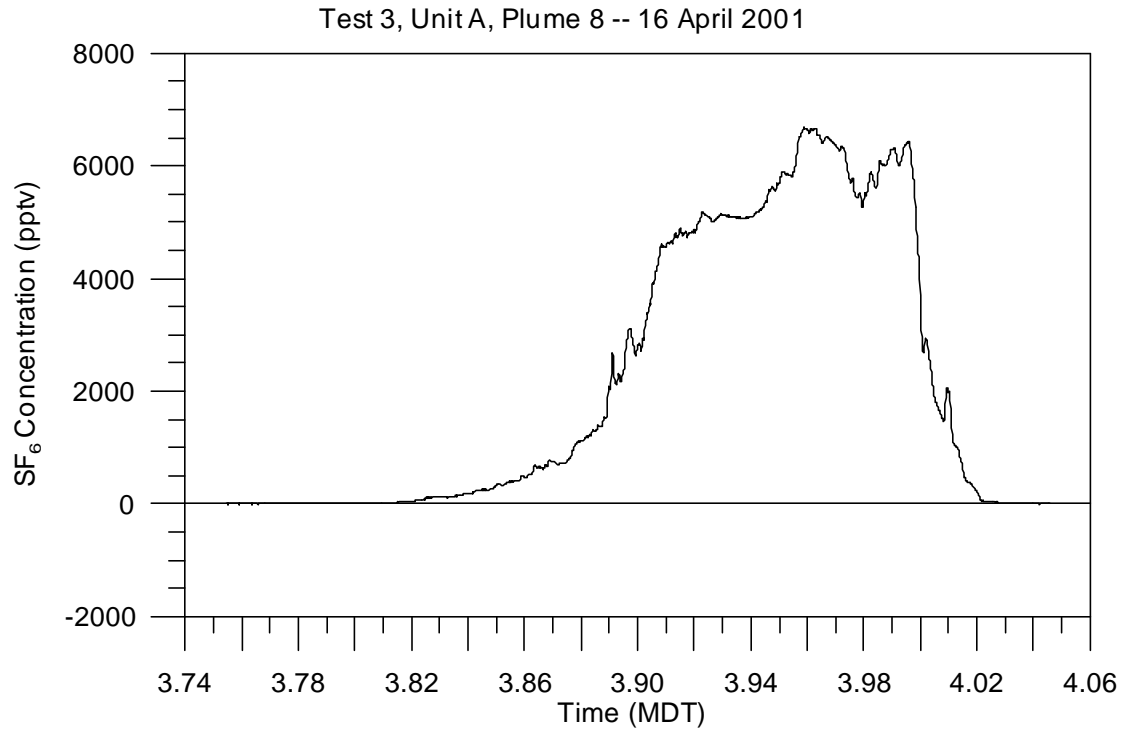


Figure A-90. SF₆ concentration of Plume 8 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

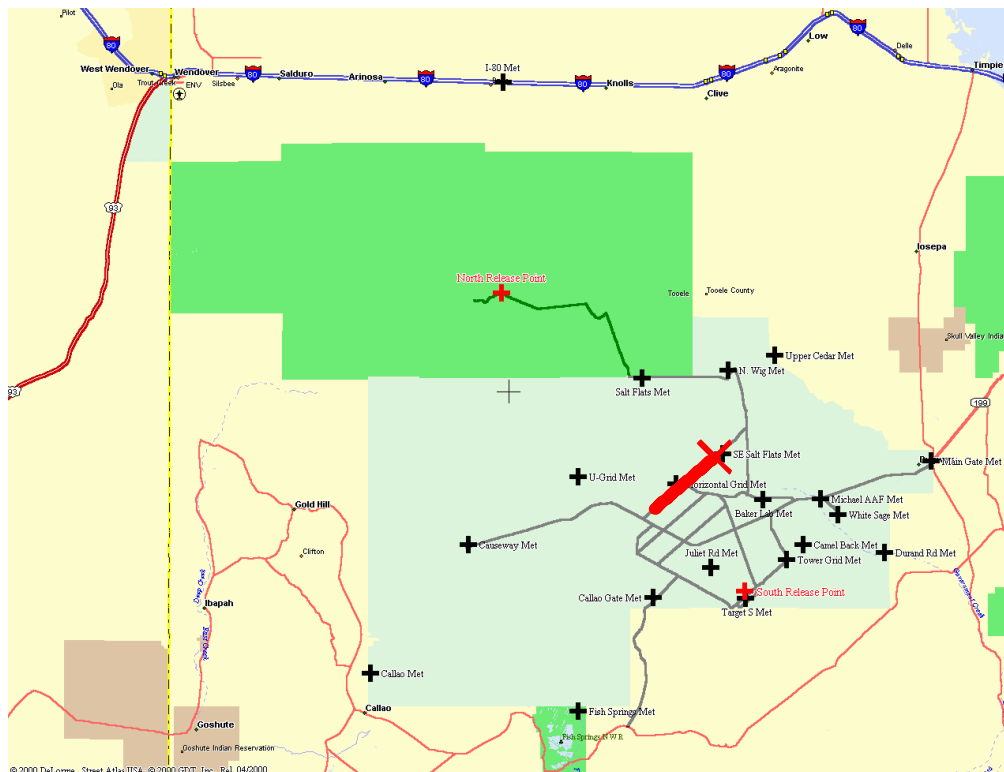
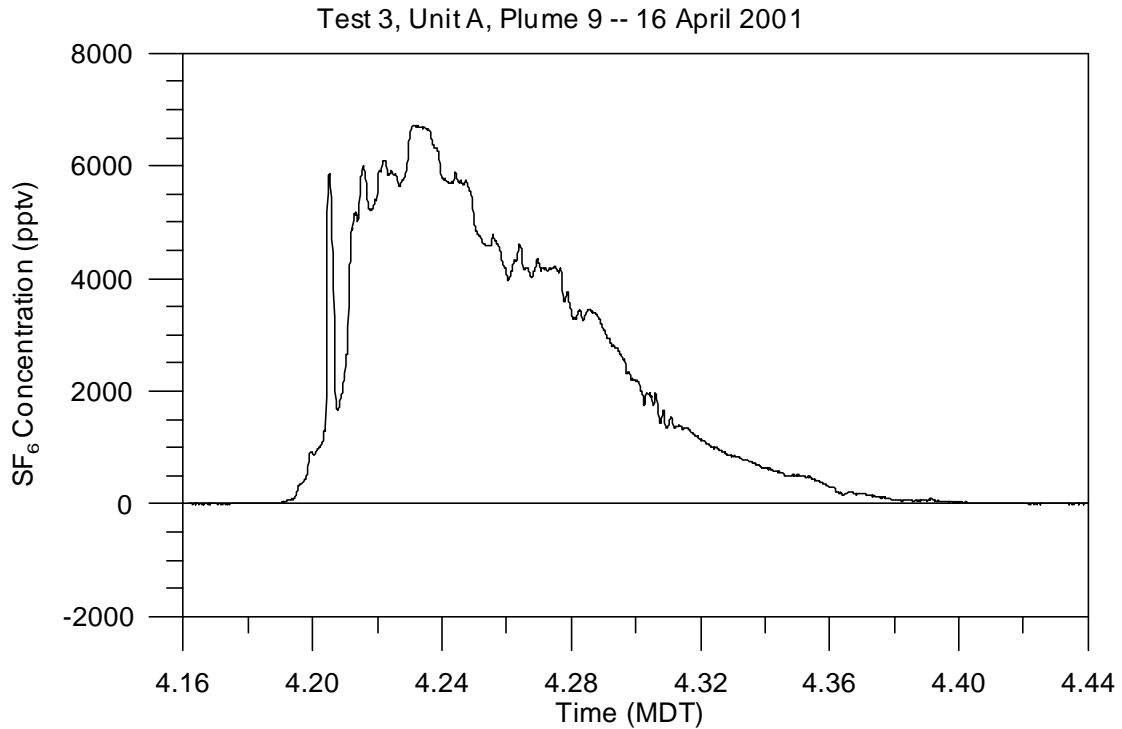


Figure A-91. SF₆ concentration of Plume 9 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

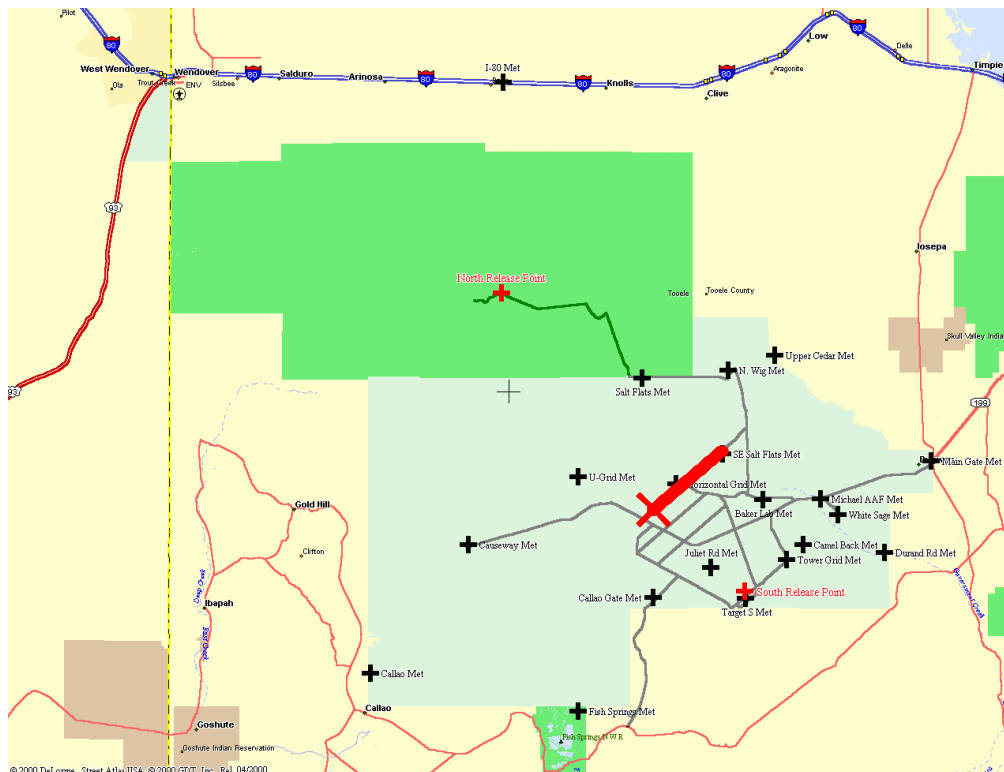
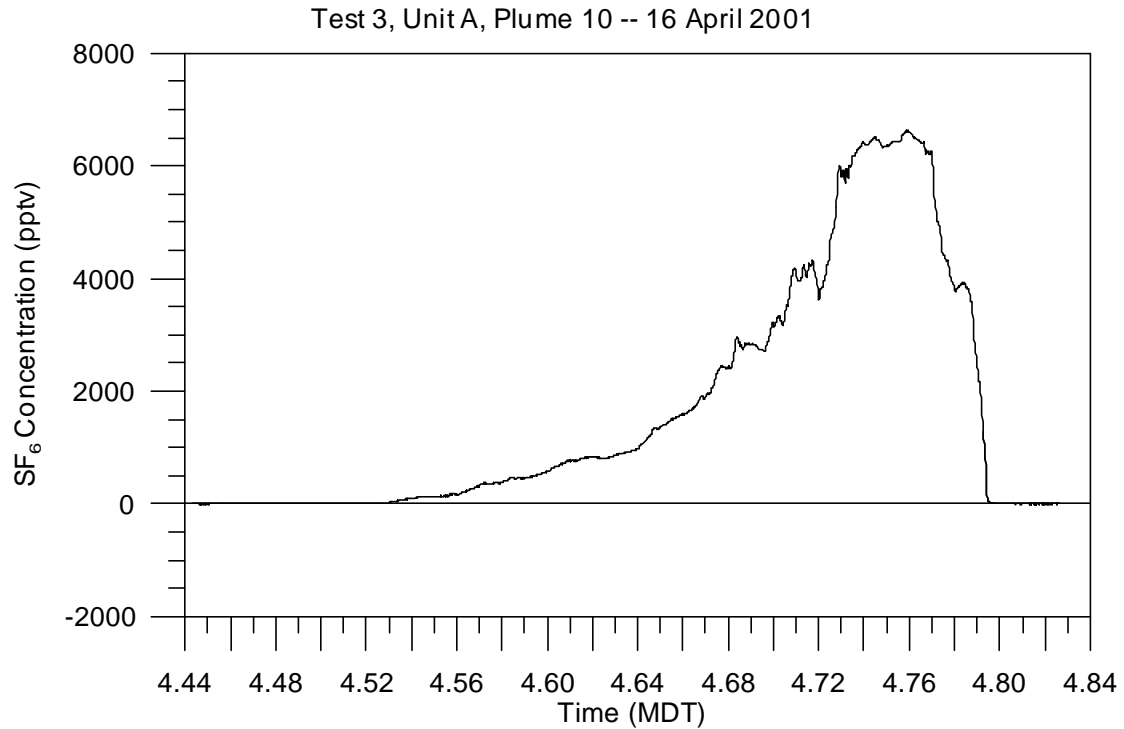


Figure A-92. SF₆ concentration of Plume 10 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

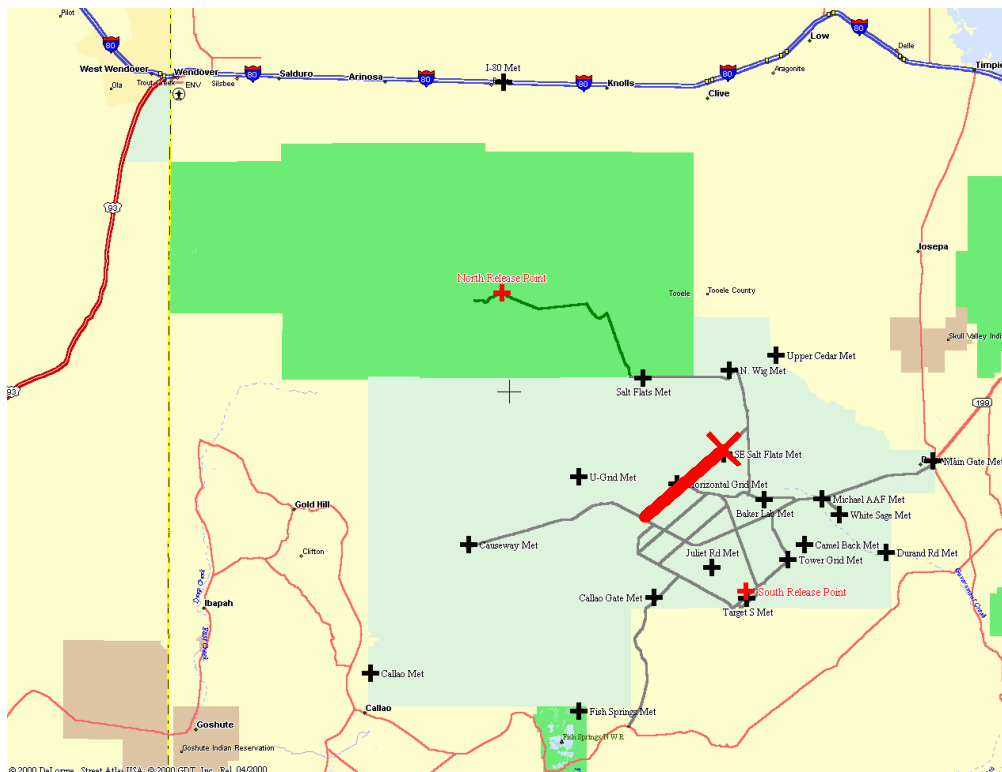
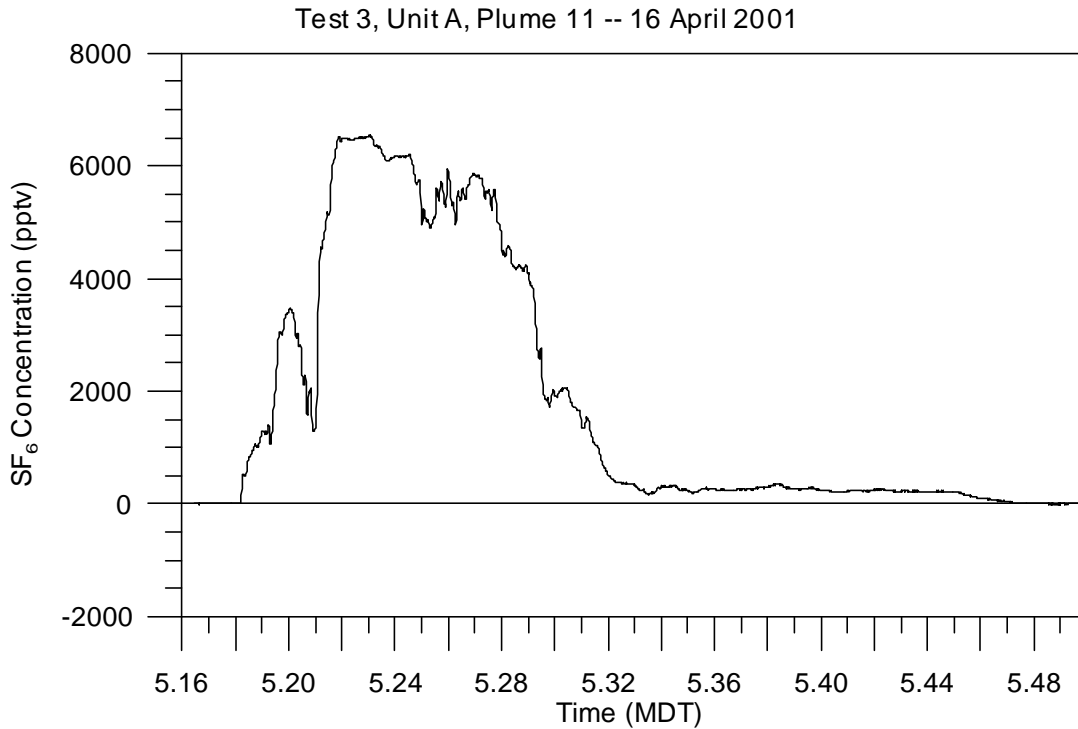


Figure A-93. SF₆ concentration of Plume 11 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

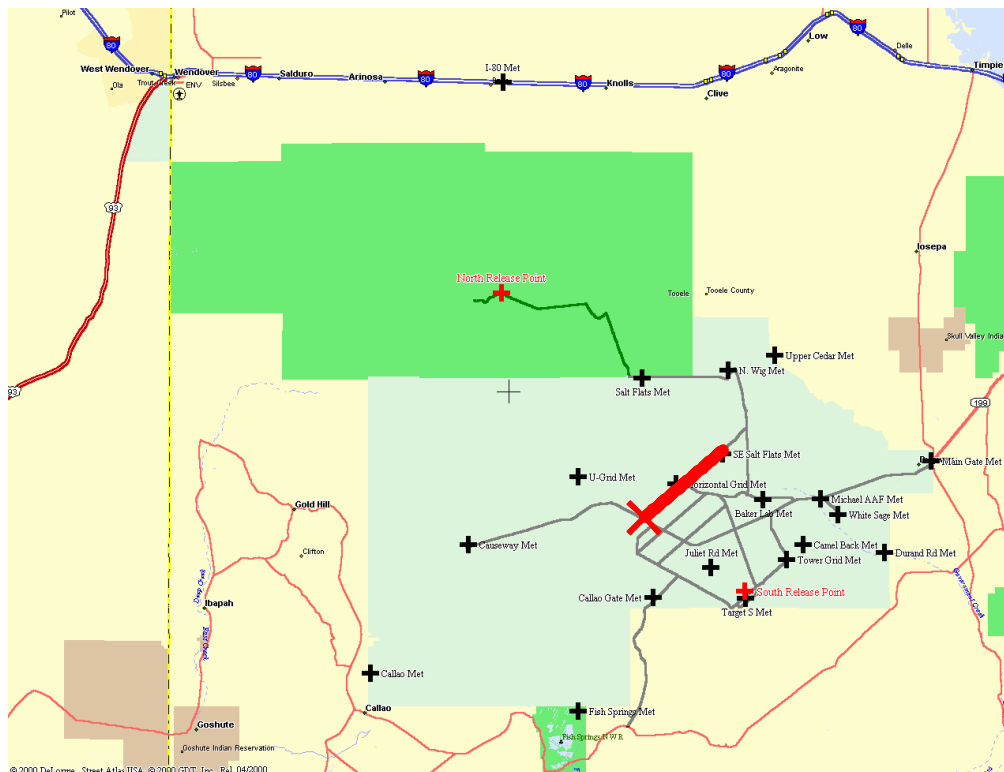
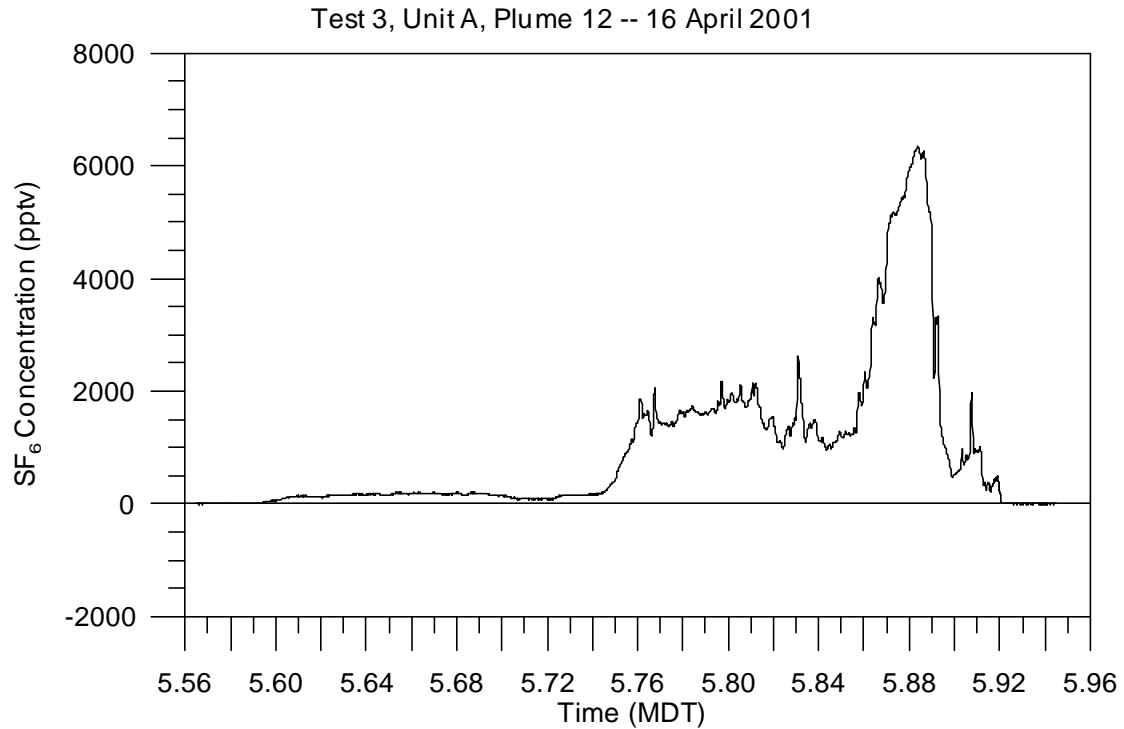


Figure A-94. SF₆ concentration of Plume 12 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

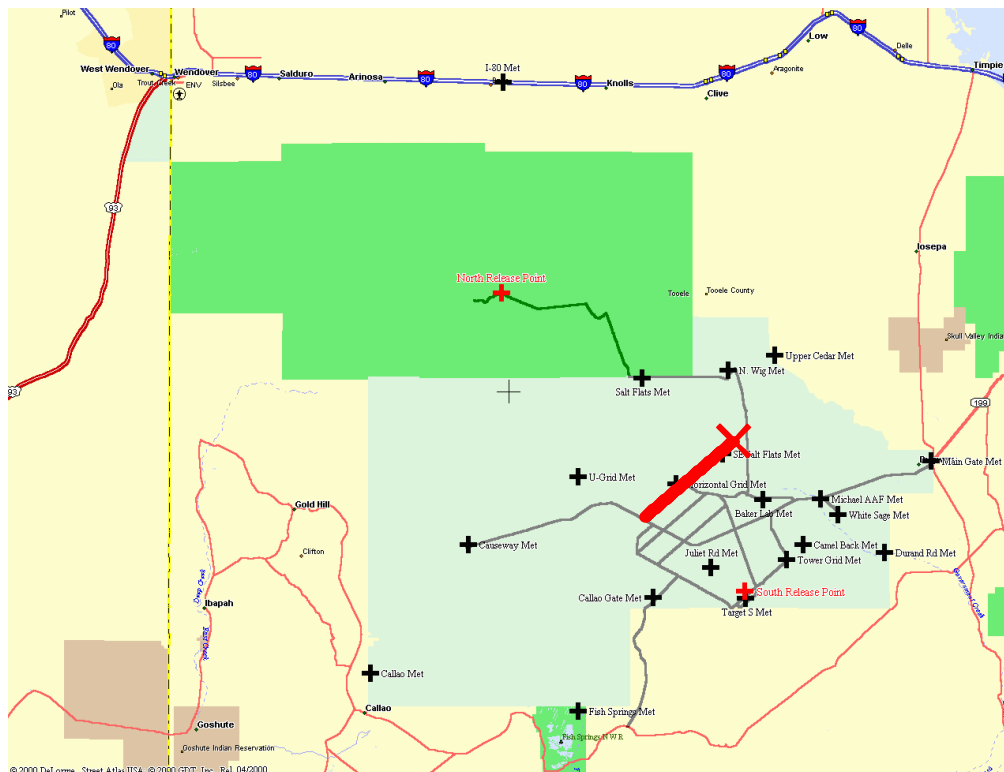
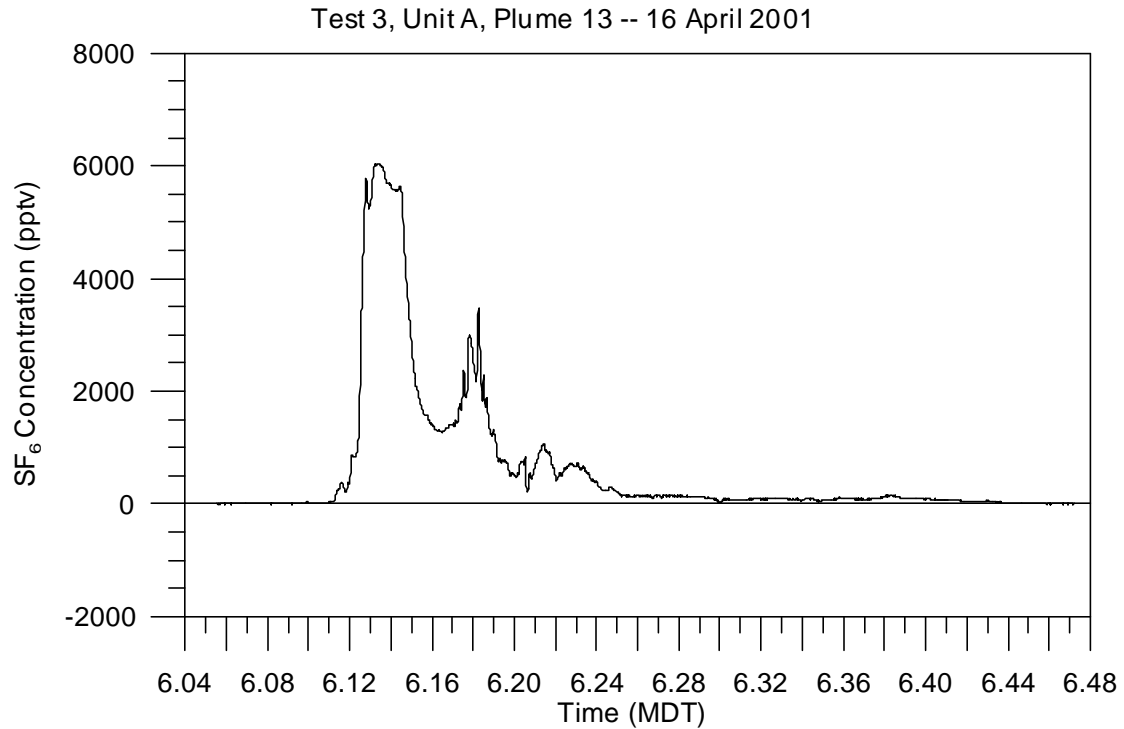


Figure A-95. SF₆ concentration of Plume 13 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

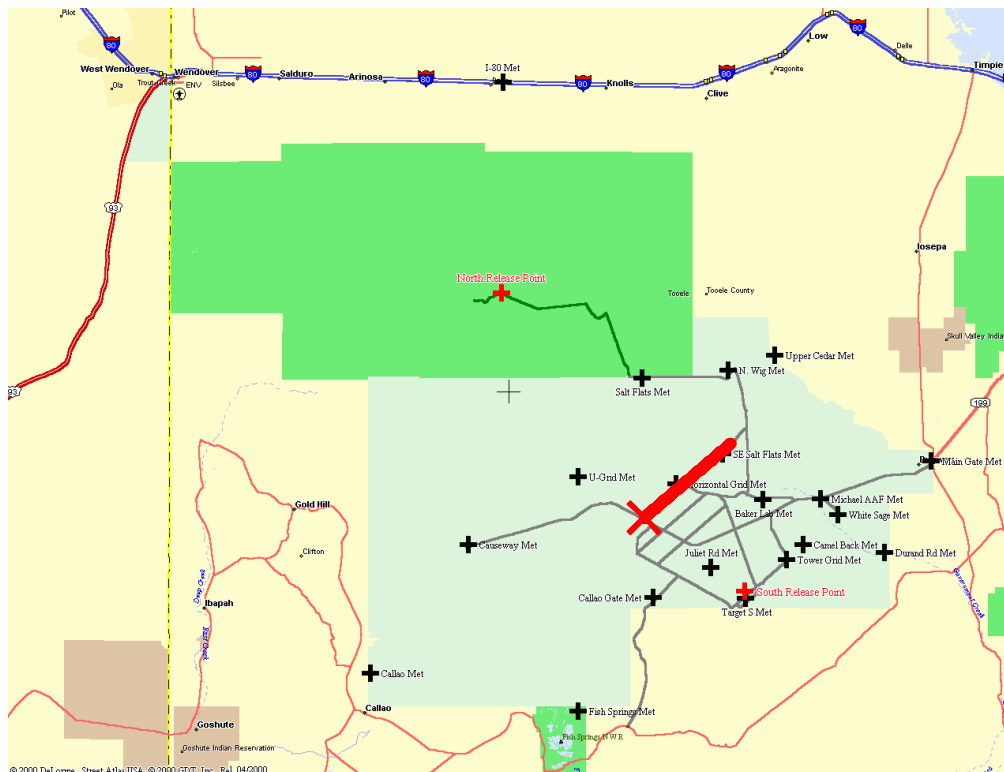
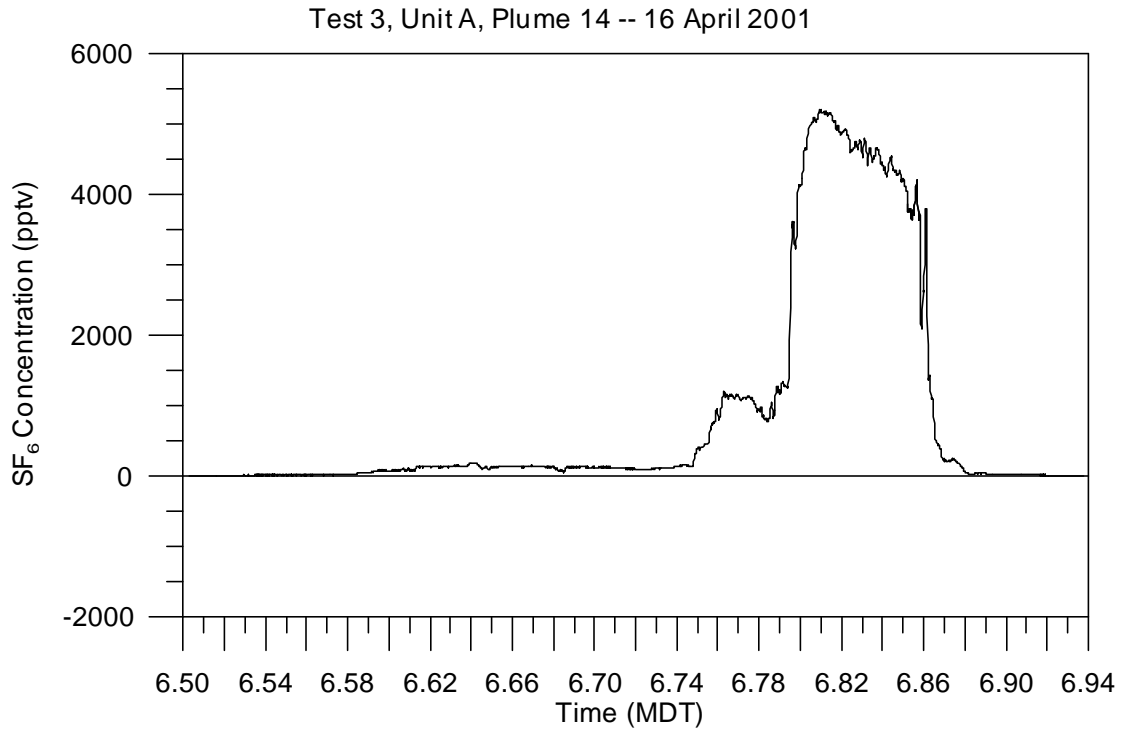


Figure A-96. SF₆ concentration of Plume 14 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

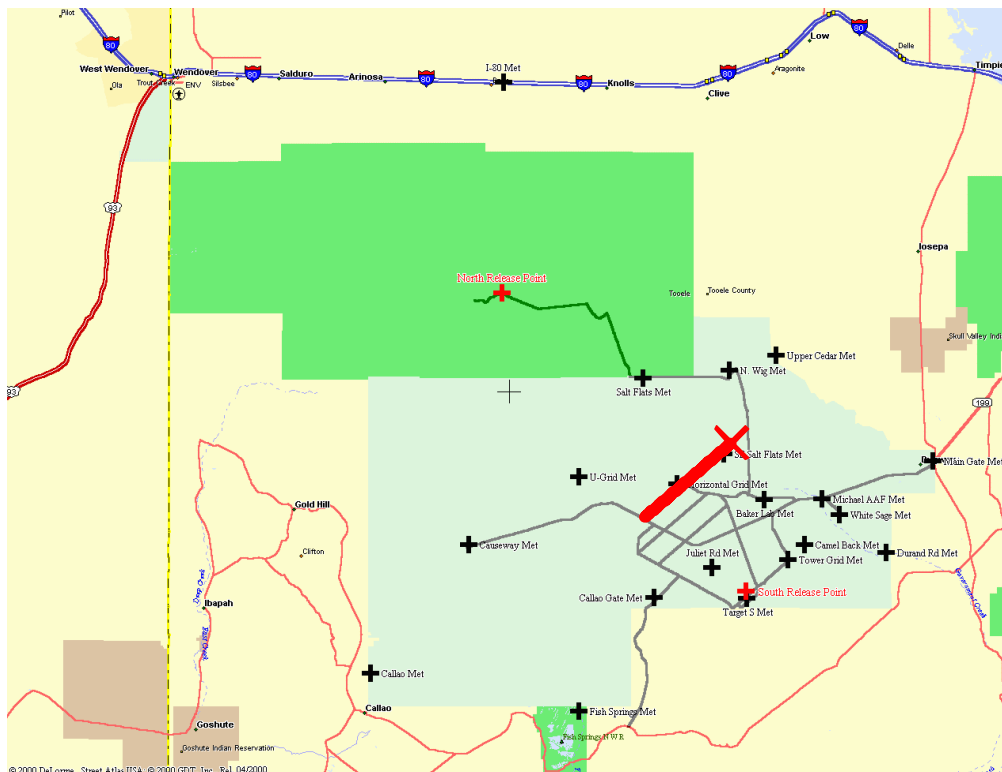
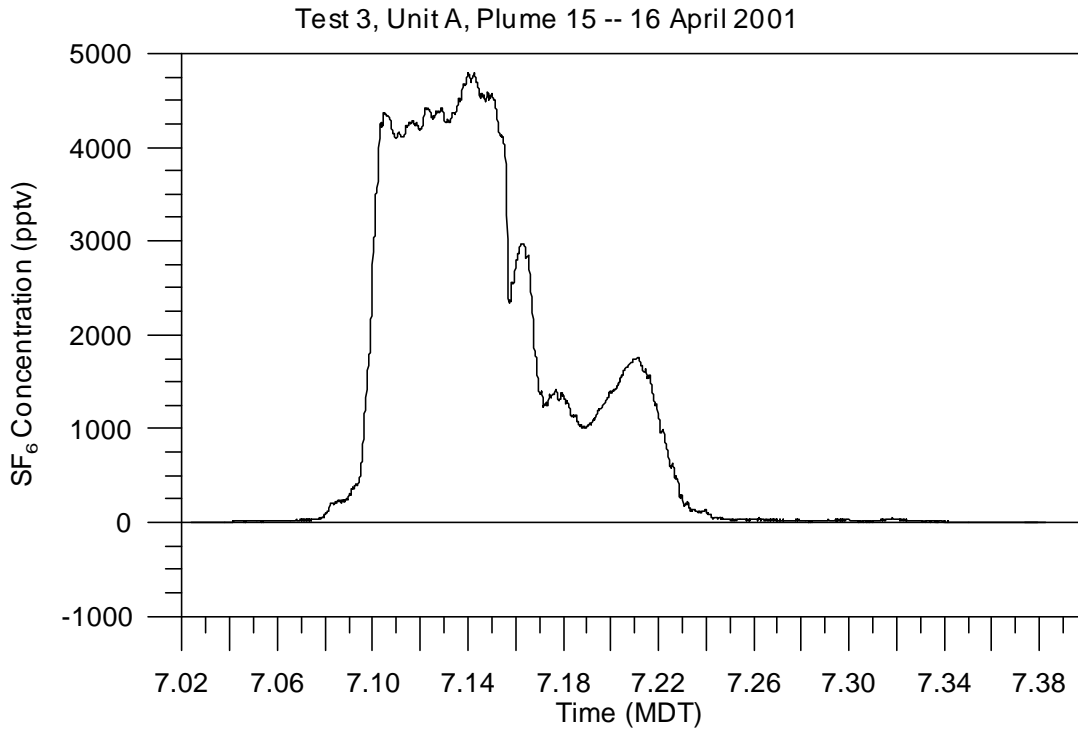


Figure A-97. SF₆ concentration of Plume 15 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

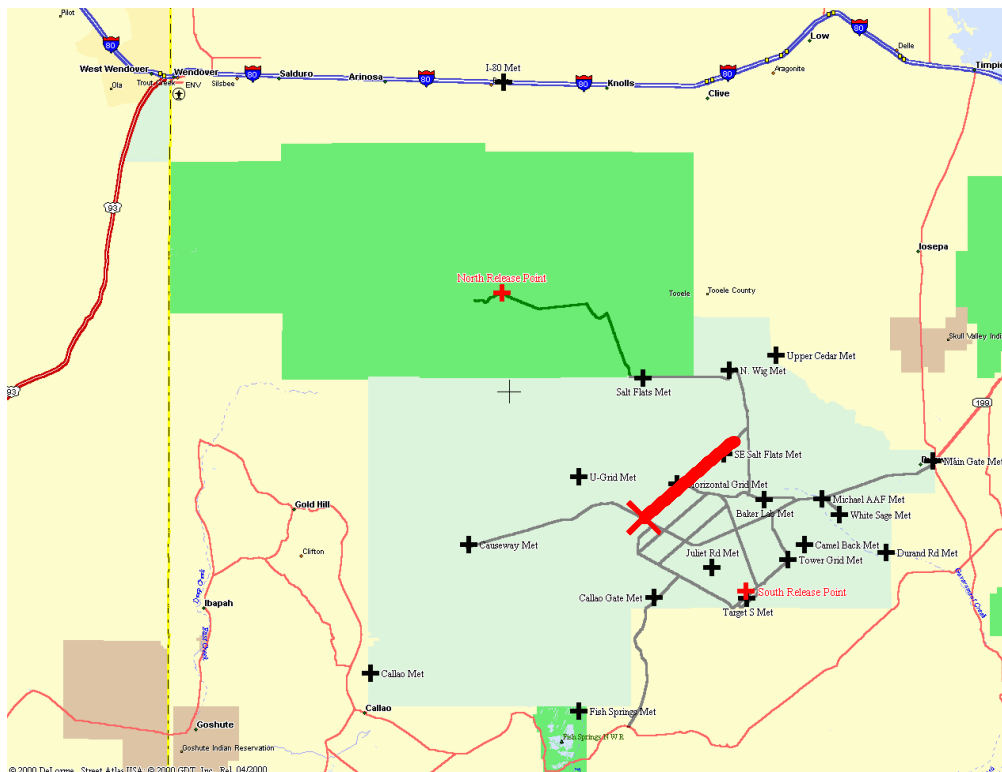
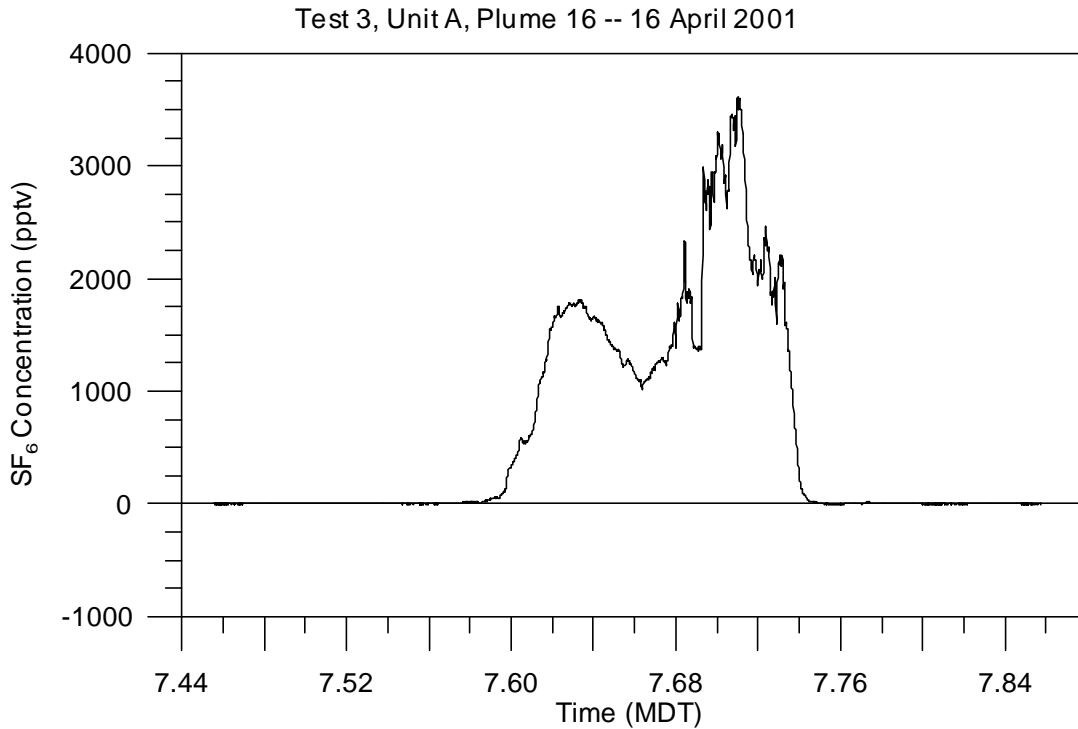


Figure A-98. SF₆ concentration of Plume 16 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

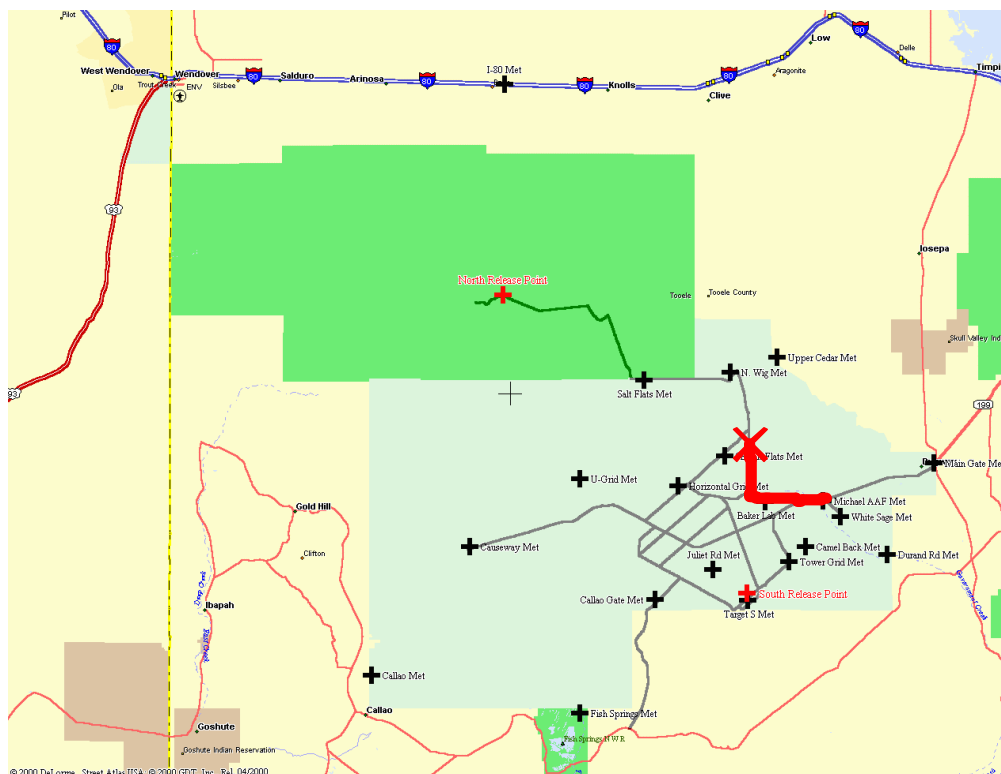
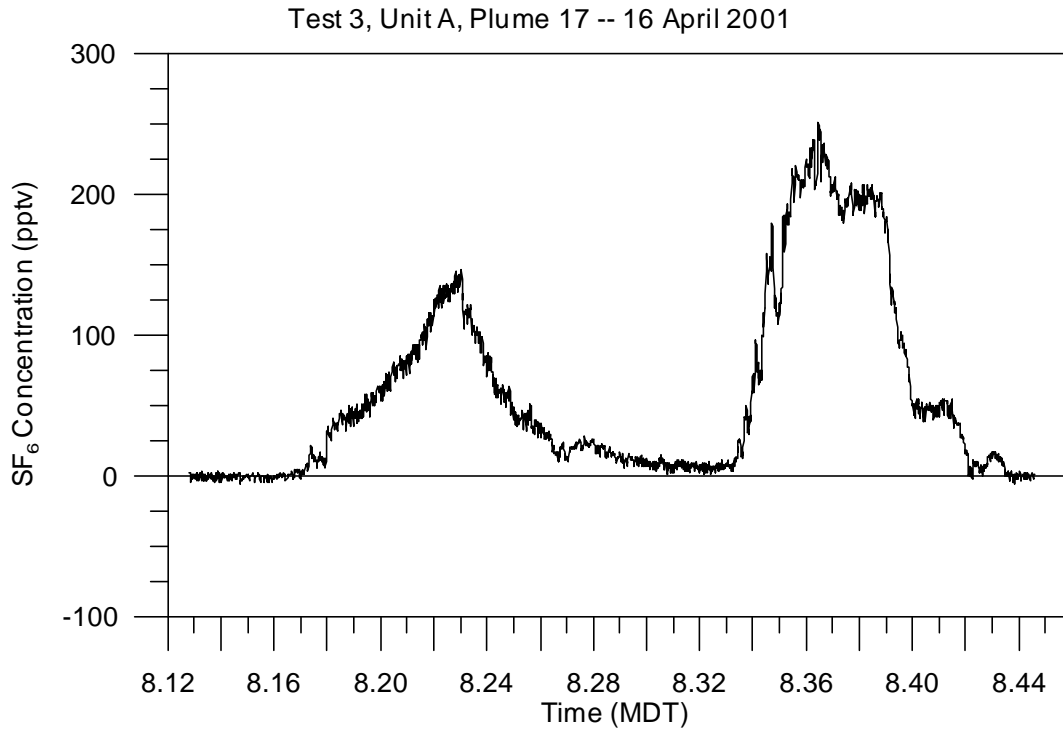


Figure A-99. SF₆ concentration of Plume 17 for Sampling Unit A during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 3 Sampling Unit B

Table A-25. Test 3 Sampling Unit B sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	2:35	2:43
2	2:50	3:05

Table A-26. Summary of individual SF₆ plume characteristics measured by Sampling Unit B during Test 3. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	3:27-3:40	1521	331.5-342.9	32.82	34.78	37.84
2	3:49-4:23	4121	327.4-346.1	32.33	35.74	42.05
3	5:12-5:27	1816	328.4-334.5	45.26	46.58	49.15
4	5:59-6:10	1363	327.7-331.5	47.96	48.57	49.44
5	6:17-7:05	5820	328.0-354.2	31.34	38.56	49.30
6	7:30-7:46	1912	331.1-350.3	31.84	33.52	35.72
7	7:46-7:53	856	327.4-330.8	35.48	35.52	35.66
8	7:53-7:58	613	327.4-331.0	35.48	35.54	35.69
9	7:58-8:12	1738	331.2-348.5	32.04	33.67	35.72

Table A-27. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit B during Test 3.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	1967.5	3:30	40.341295	113.250518	331.5	35.69
2	1934.2	4:07	40.328032	113.275450	327.4	35.50
3	580.3	5:21	40.419320	113.305690	331.5	45.55
4	270.5	6:07	40.437182	113.335518	330.0	48.52
5	3914.2*	6:48	40.341338	113.207240	337.0	34.09
6	6469.1	7:37	40.341317	113.176840	341.1	33.16
7	1297.1	7:47	40.332802	113.266350	328.9	35.54
8	1054.3	7:56	40.332453	113.267017	328.8	35.54
9	3256.0	8:05	40.341313	113.188735	339.5	33.50

*Analyzer over-ranged during this traverse, resulting in a flat-topped peak and an unknown maximum concentration.

No null passes were made by Sampling Unit B either during or after the time period of active plume sampling listed in the previous two tables.

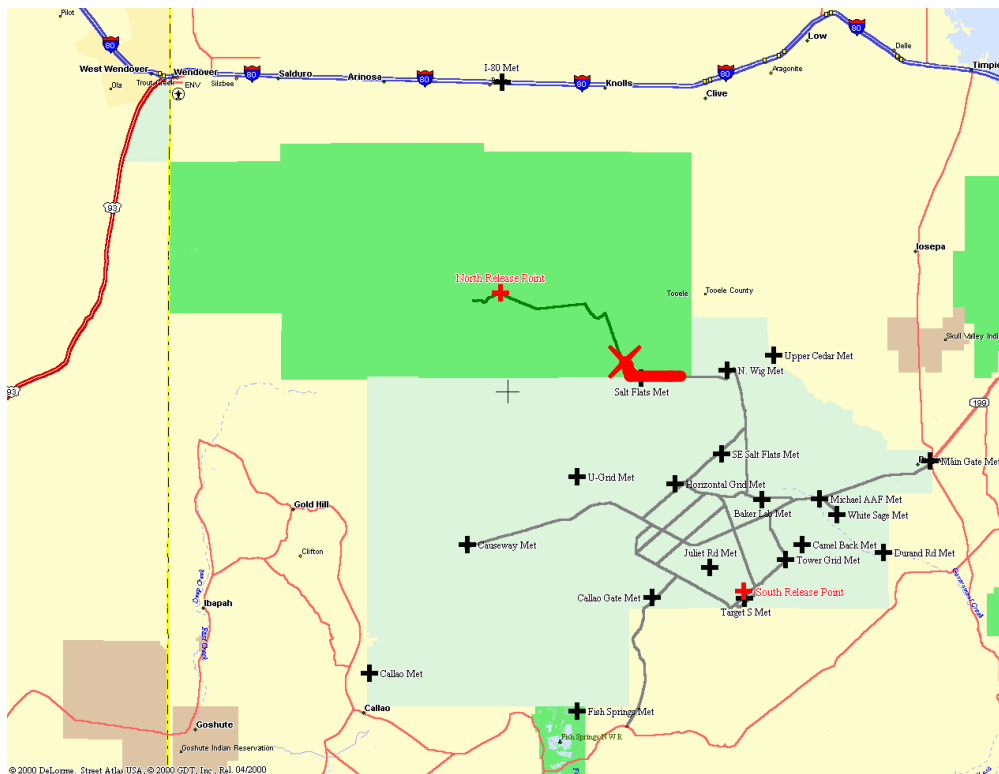
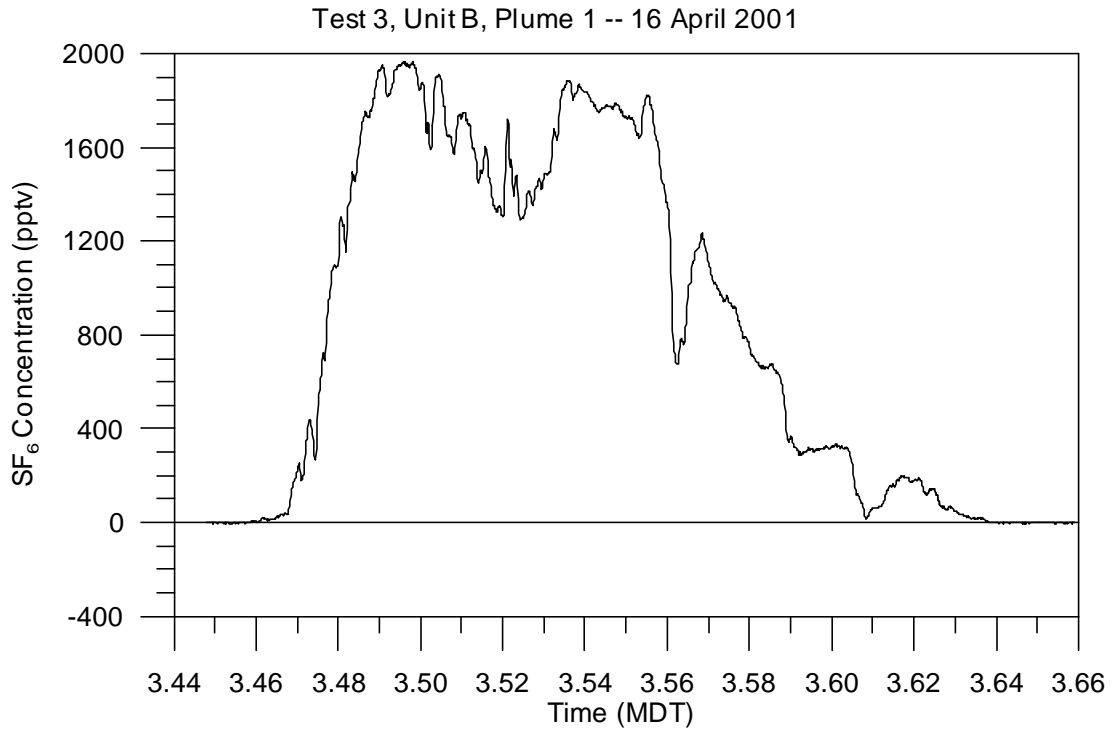


Figure A-102. SF₆ concentration of Plume 1 for Sampling Unit B during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

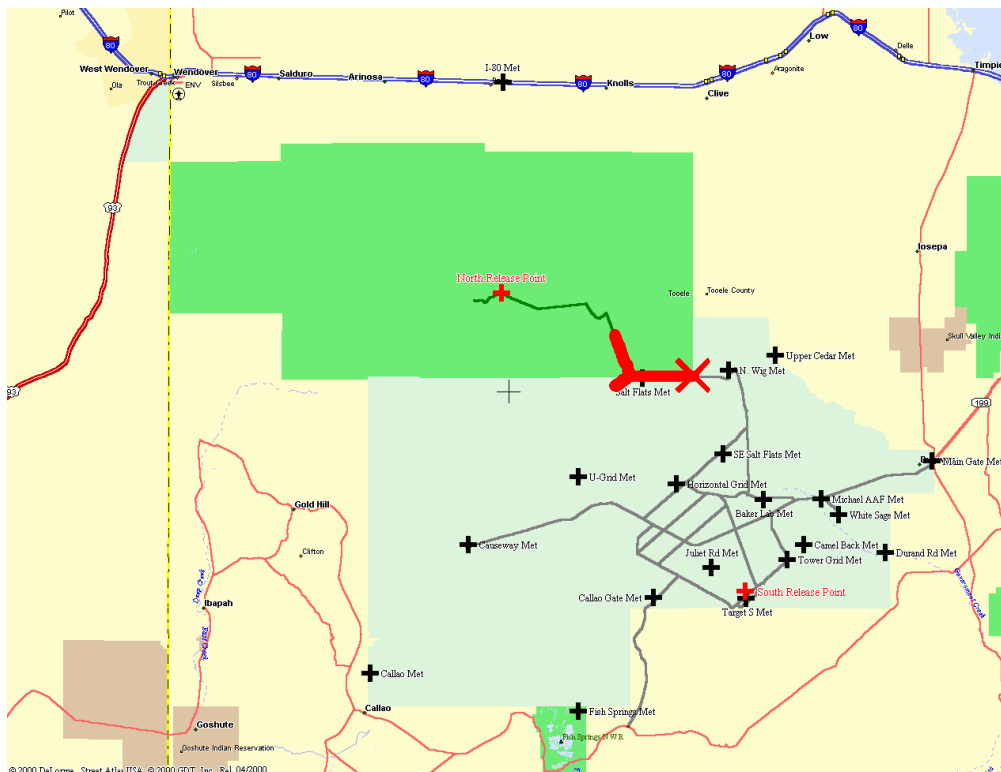
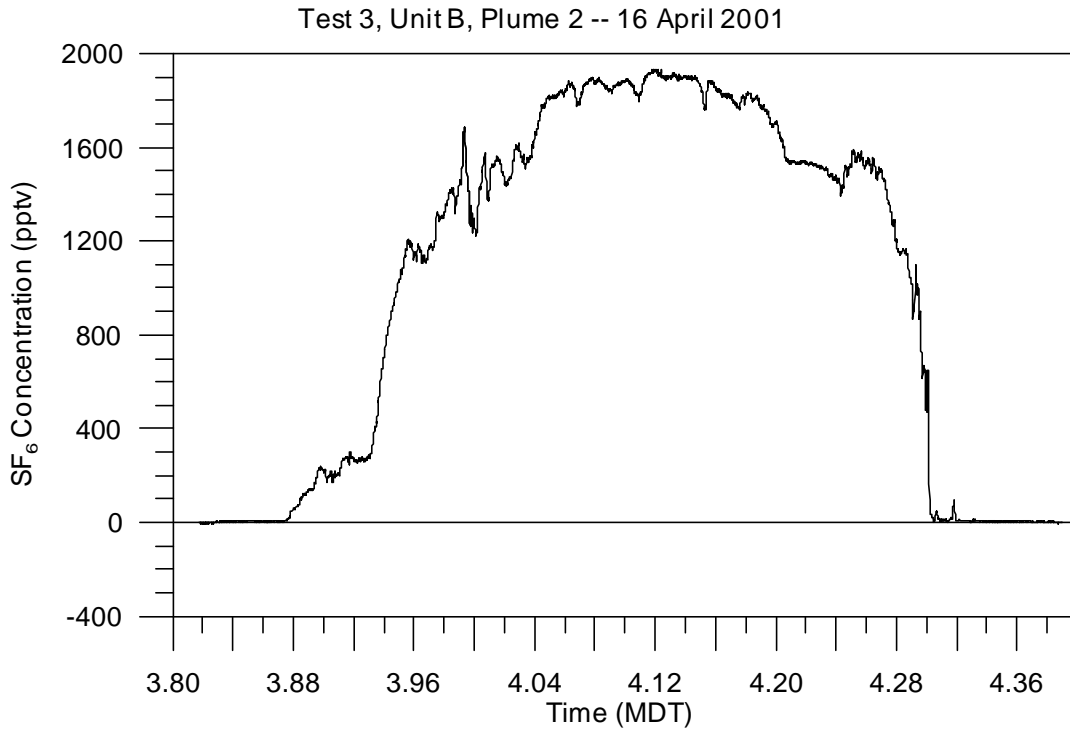


Figure A-103. SF₆ concentration of Plume 2 for Sampling Unit B during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

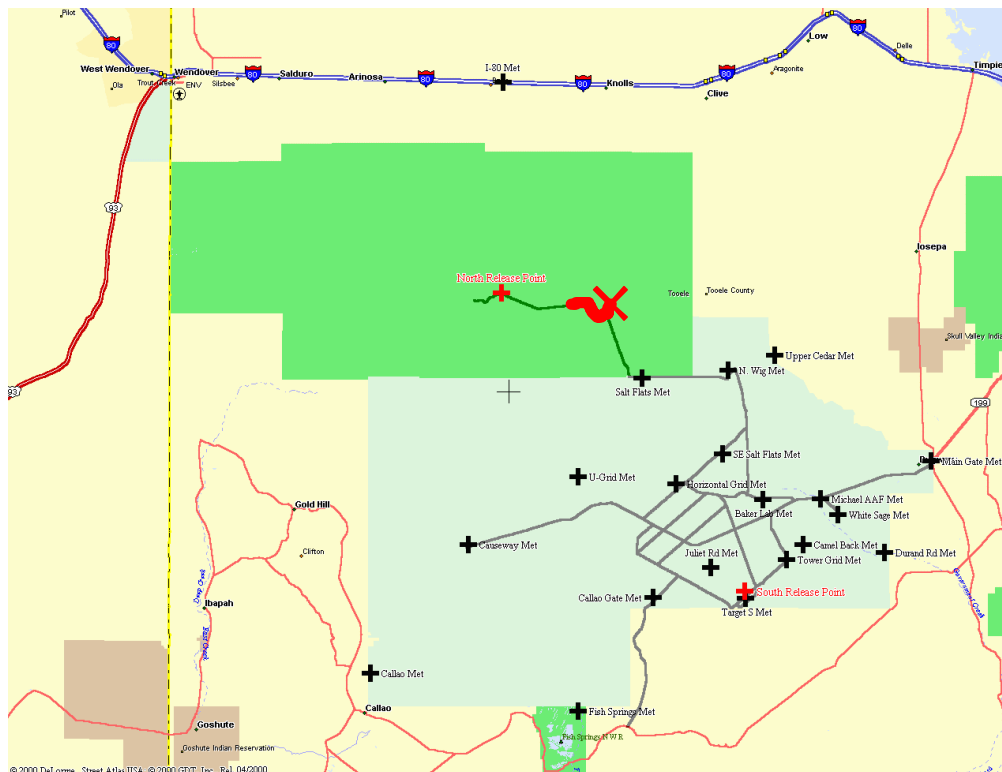
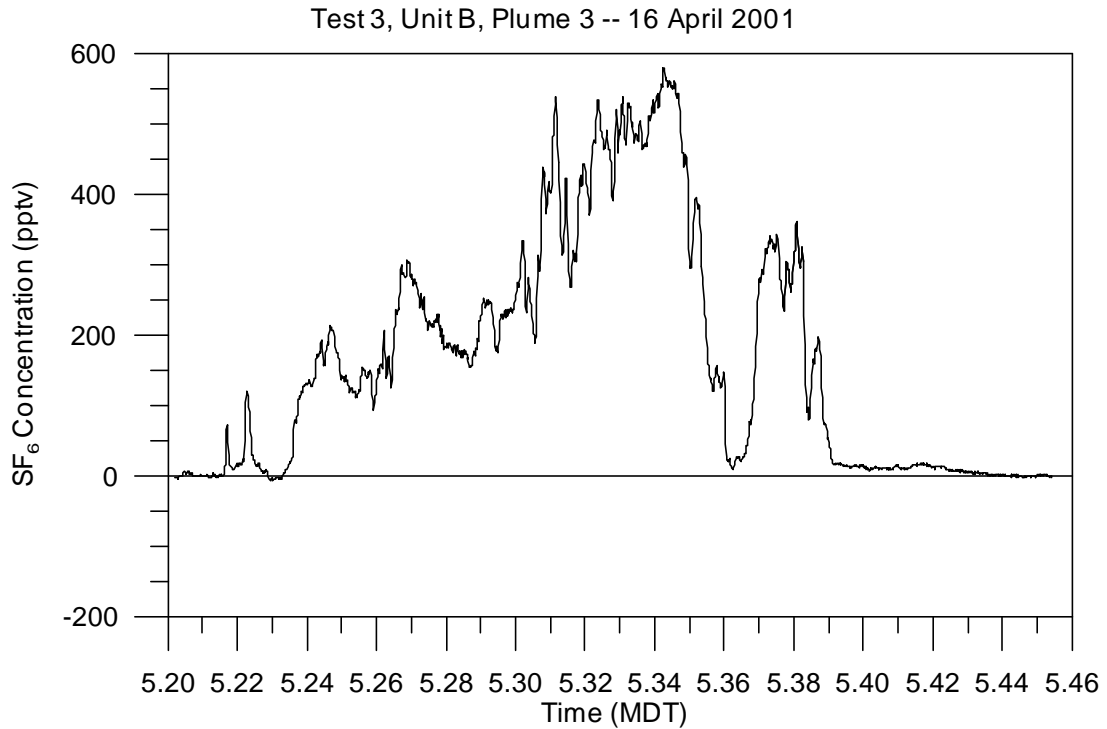


Figure A-104. SF₆ concentration of Plume 3 for Sampling Unit B during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

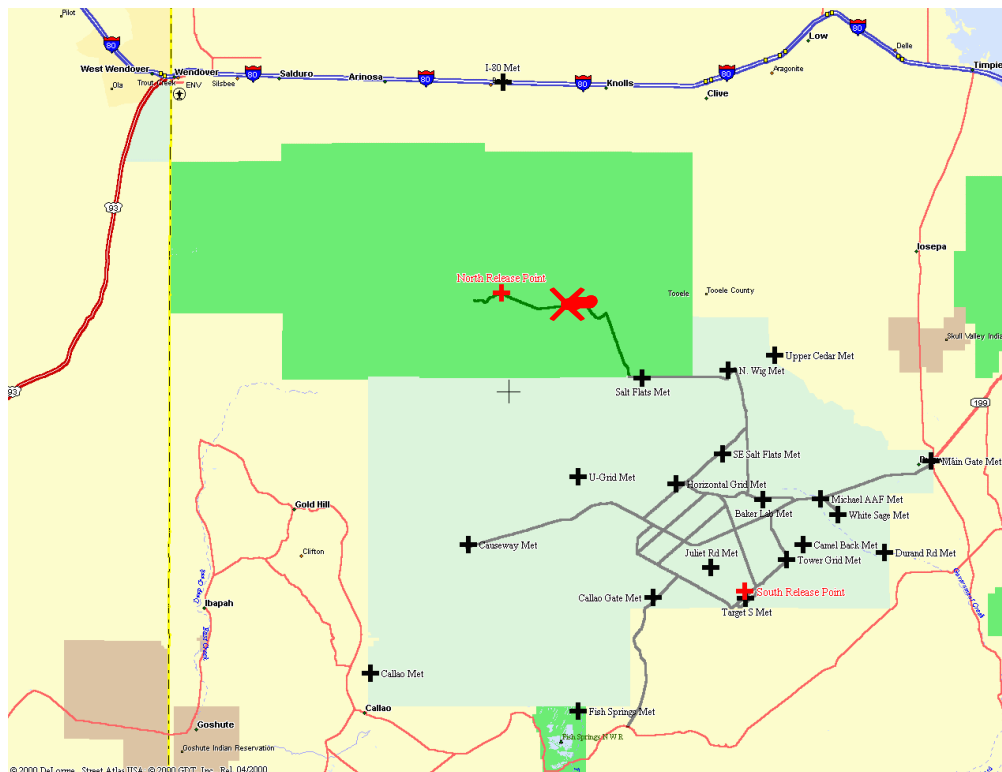
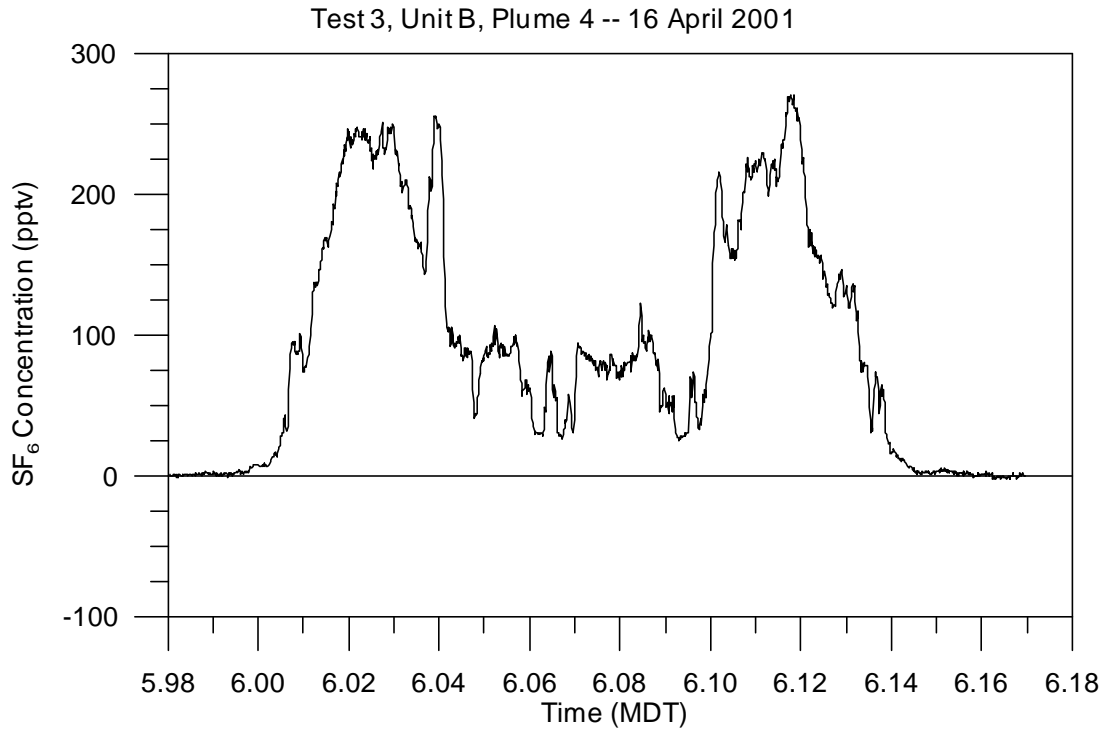


Figure A-105. SF₆ concentration of Plume 4 for Sampling Unit B during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

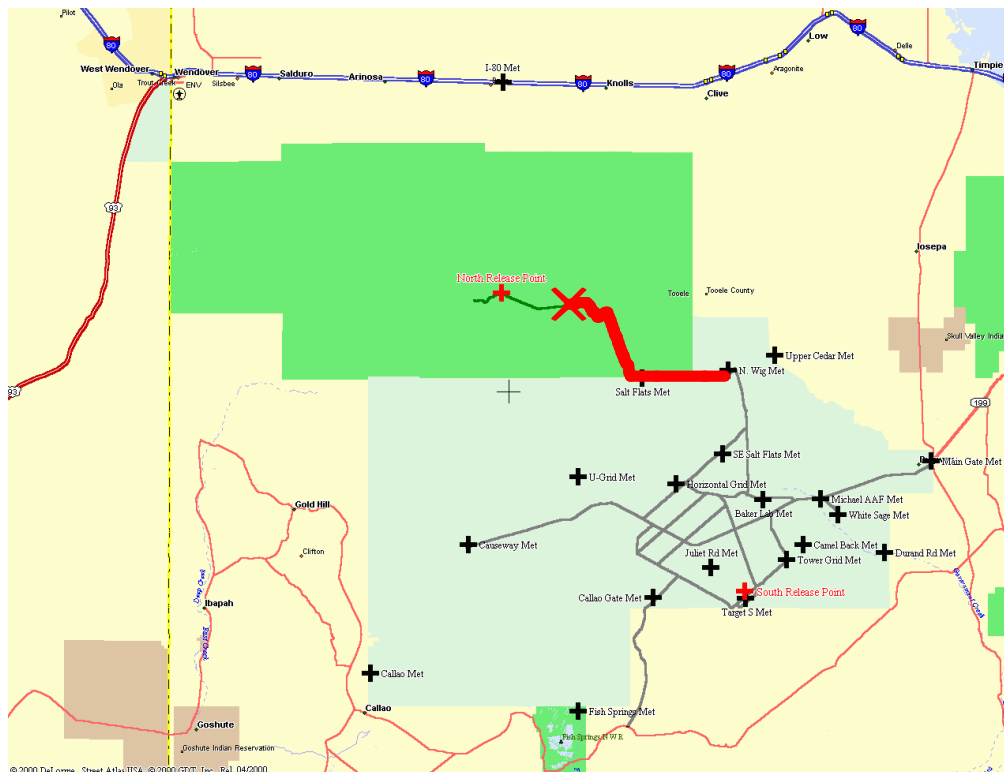
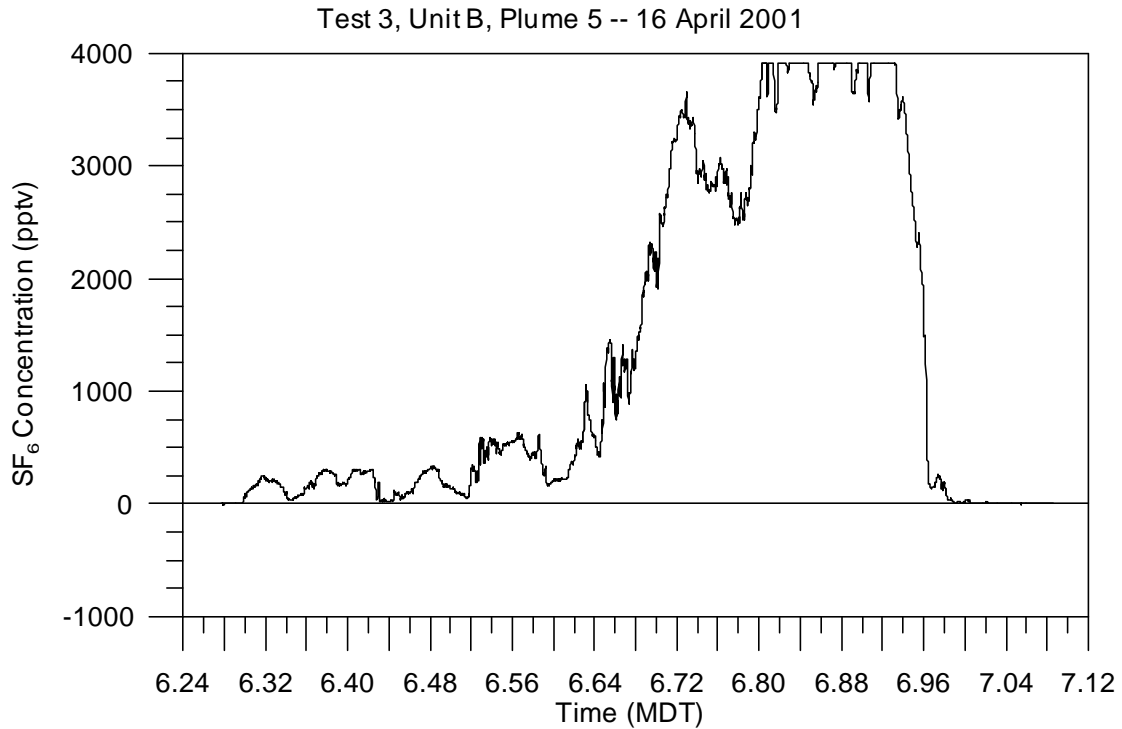


Figure A-106. SF₆ concentration of Plume 5 for Sampling Unit B during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

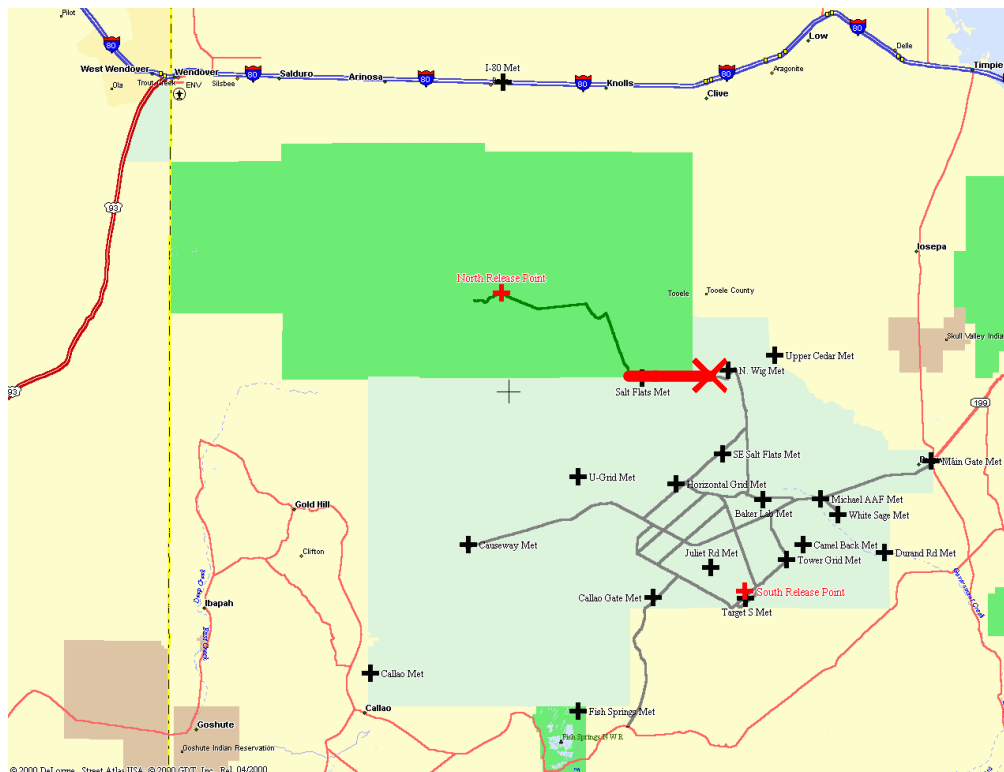
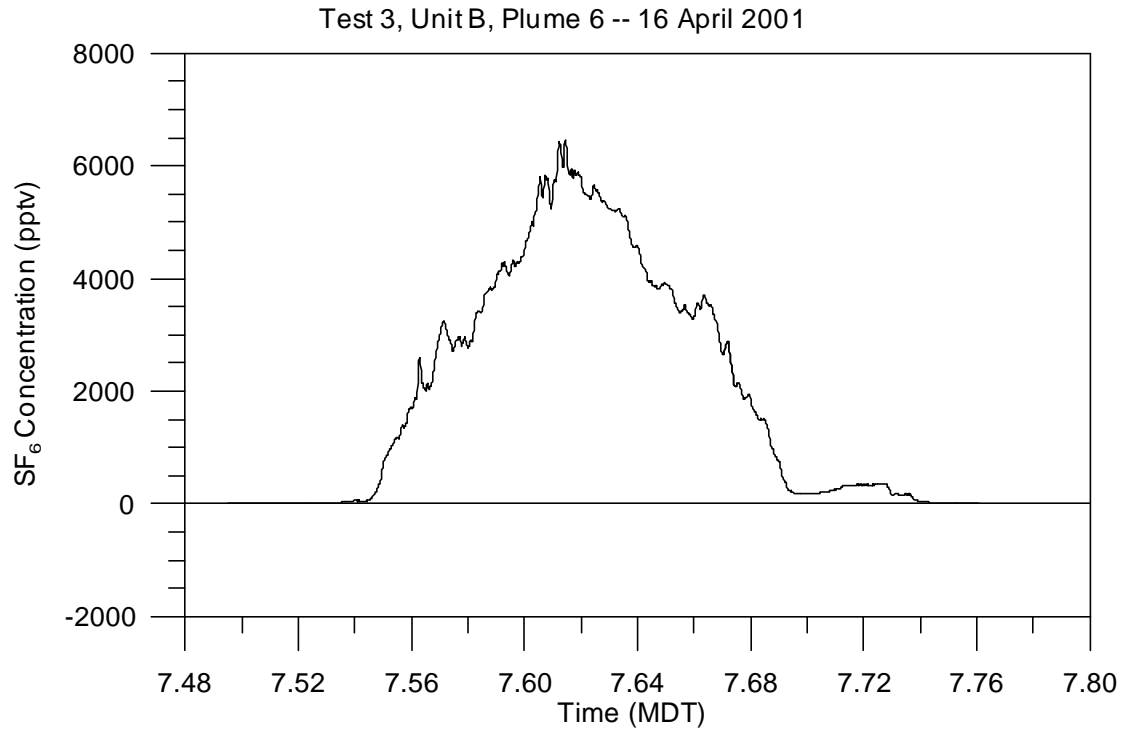


Figure A-107. SF₆ concentration of Plume 6 for Sampling Unit B during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

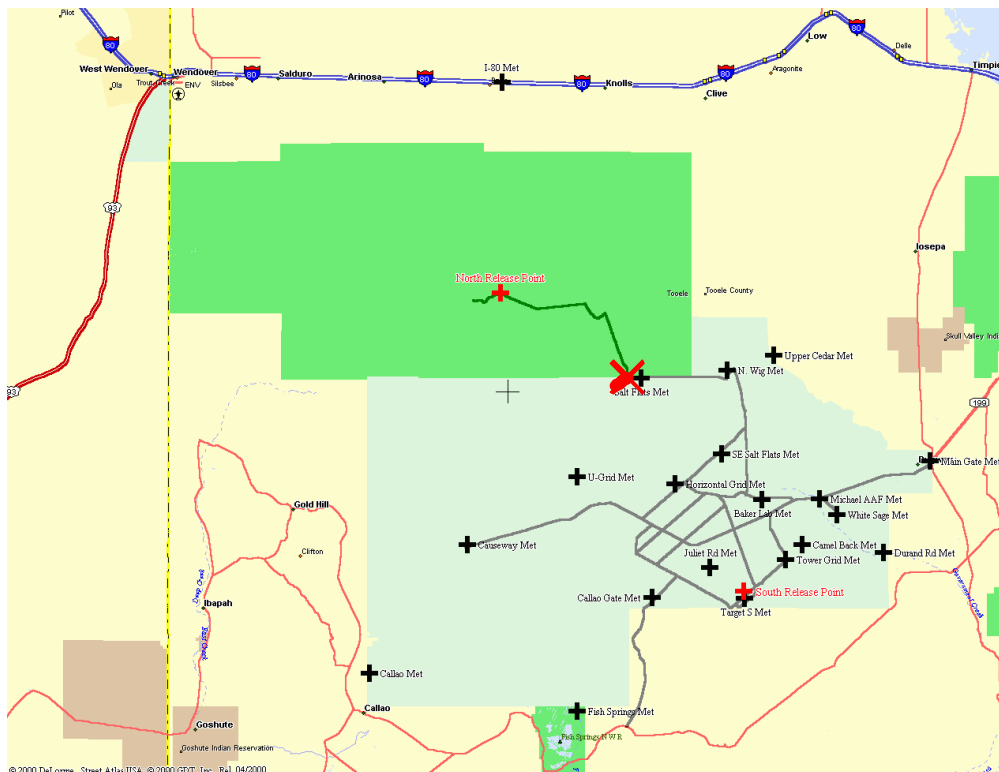
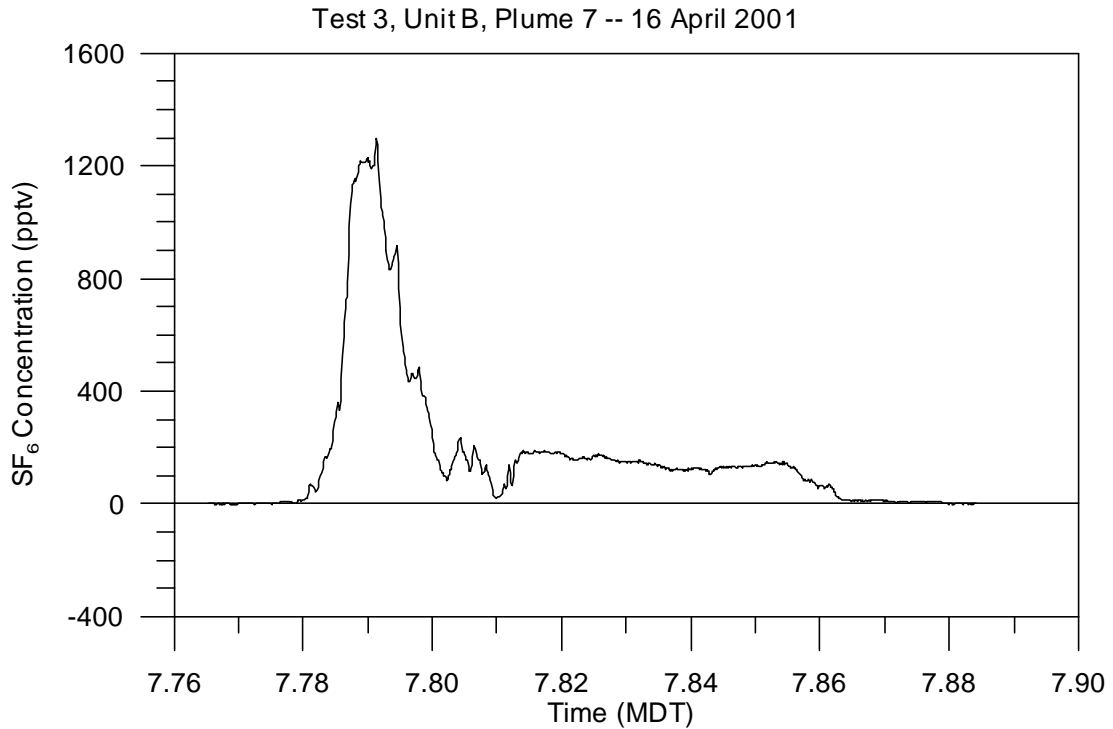


Figure A-108. SF₆ concentration of Plume 7 for Sampling Unit B during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

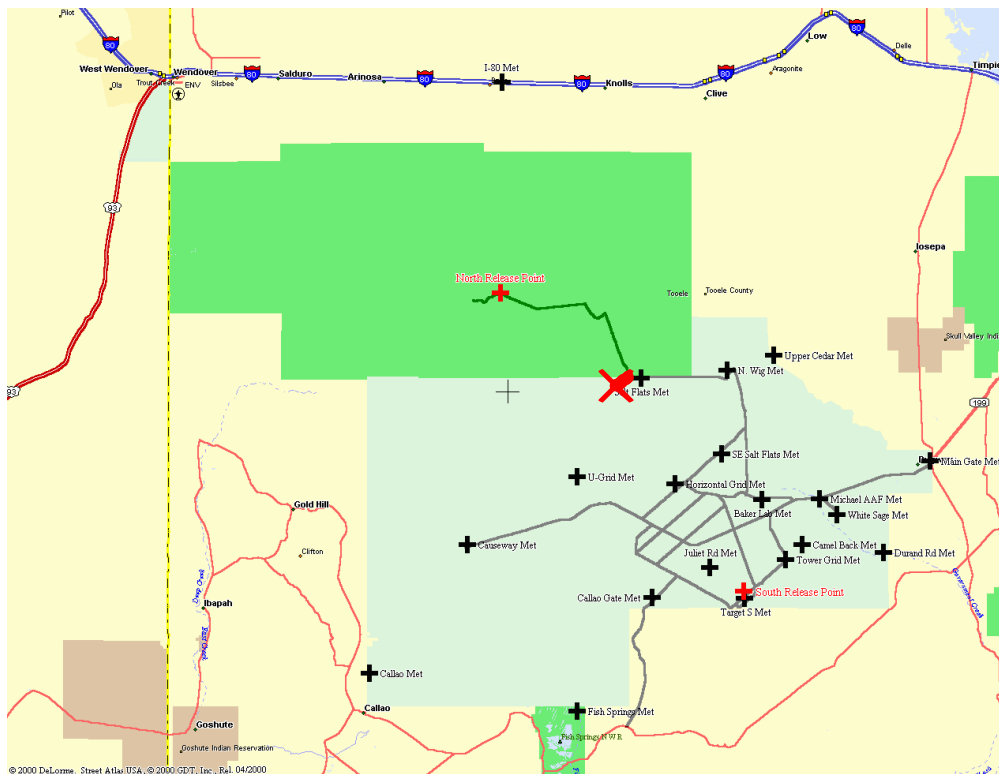
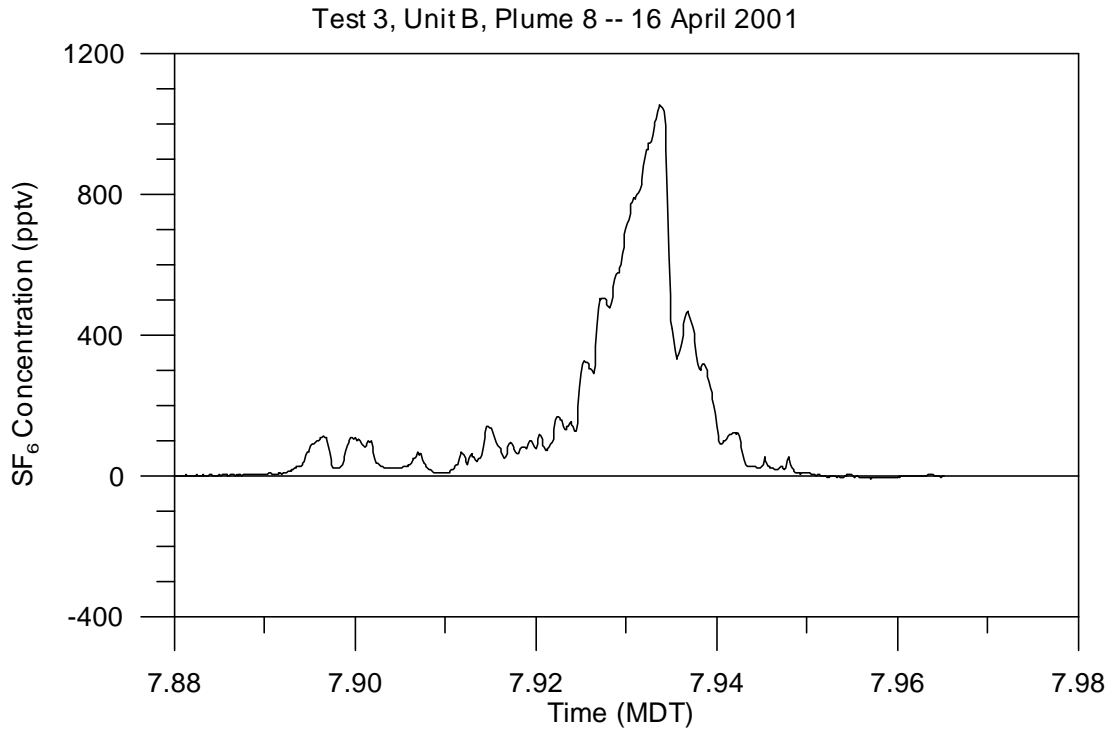


Figure A-109. SF₆ concentration of Plume 8 for Sampling Unit B during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

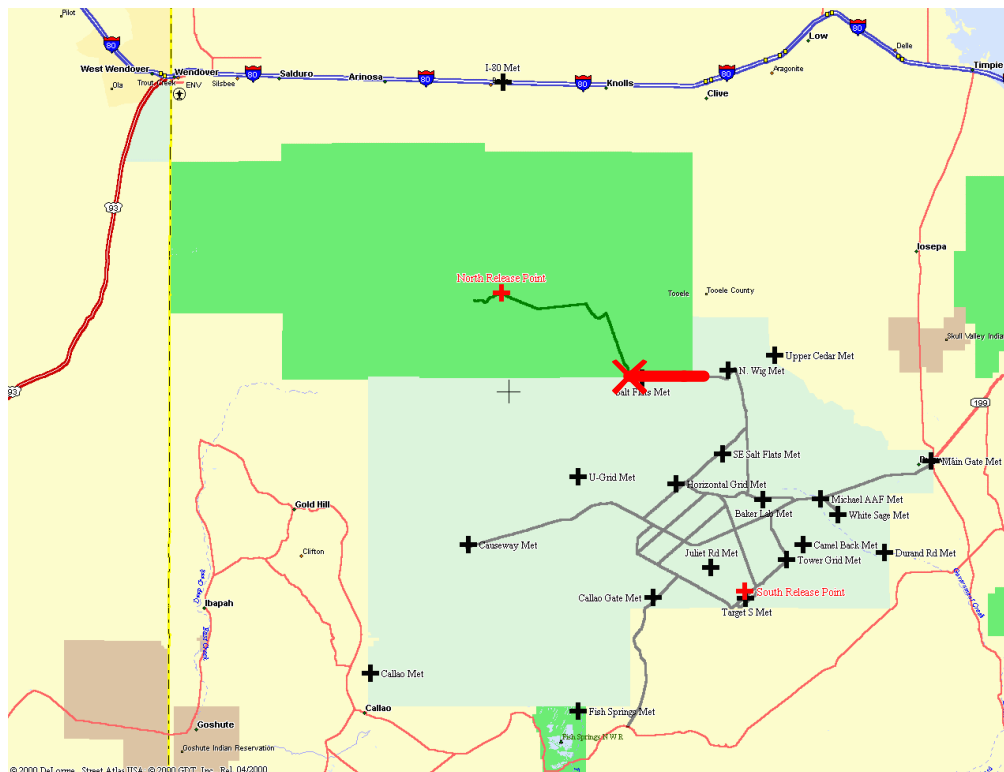
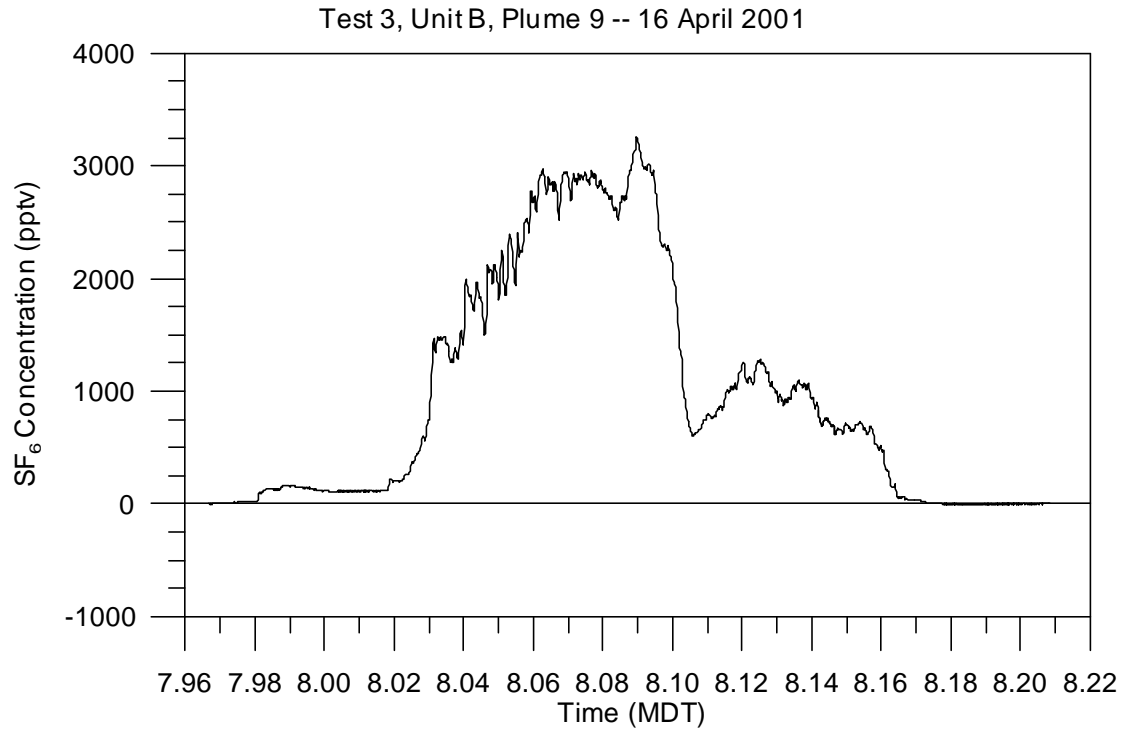


Figure A-110. SF₆ concentration of Plume 9 for Sampling Unit B during Test 3 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 3
Sampling Unit C

Table A-28. Test 3 Sampling Unit C sampling traverses yielding no detectable SF₆ (null pass).
(Sampling Unit C did not encounter any SF₆ during Test 3.)

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	1:27	2:03
2	2:04	2:36
3	2:36	3:34
4	3:41	4:33
5	4:38	5:00
6	5:02	5:38
7	5:48	6:25
8	6:34	7:09
9	7:15	7:51

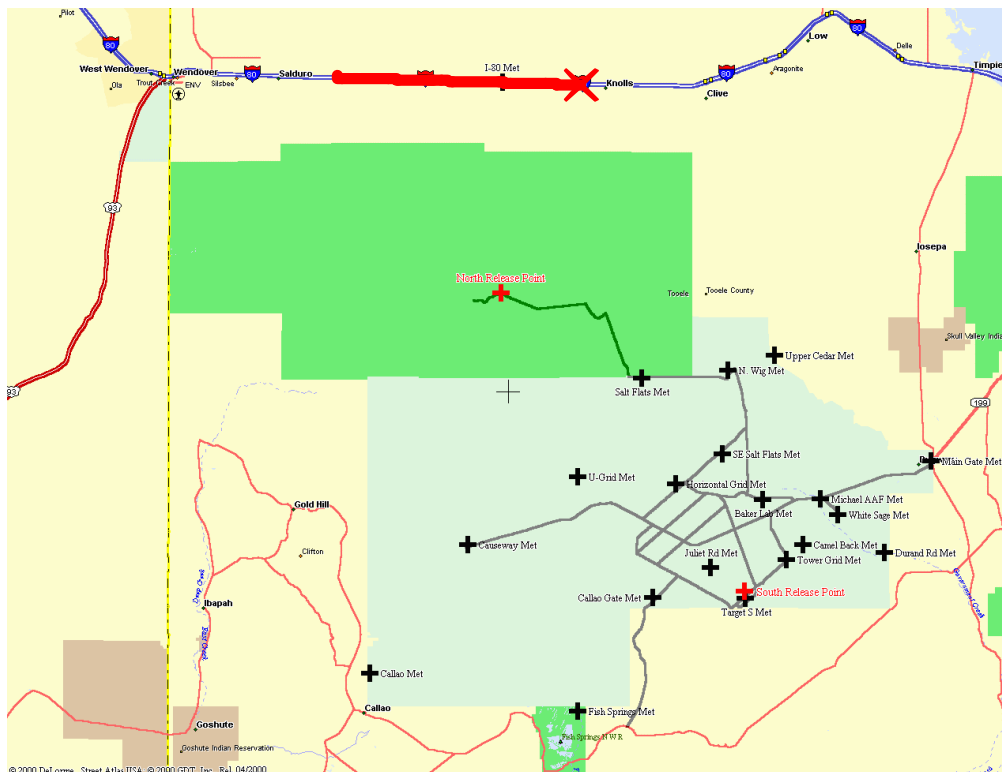
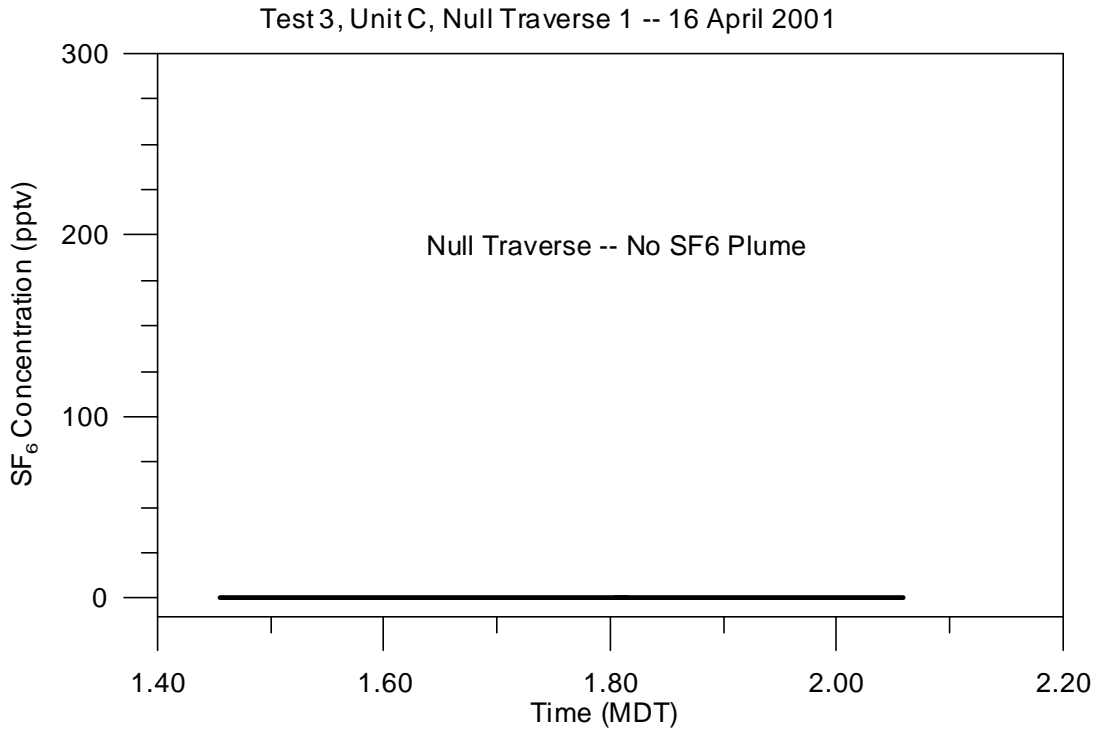


Figure A-111. Null sampling traverse 1 made by Sampling Unit C during Test 3, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

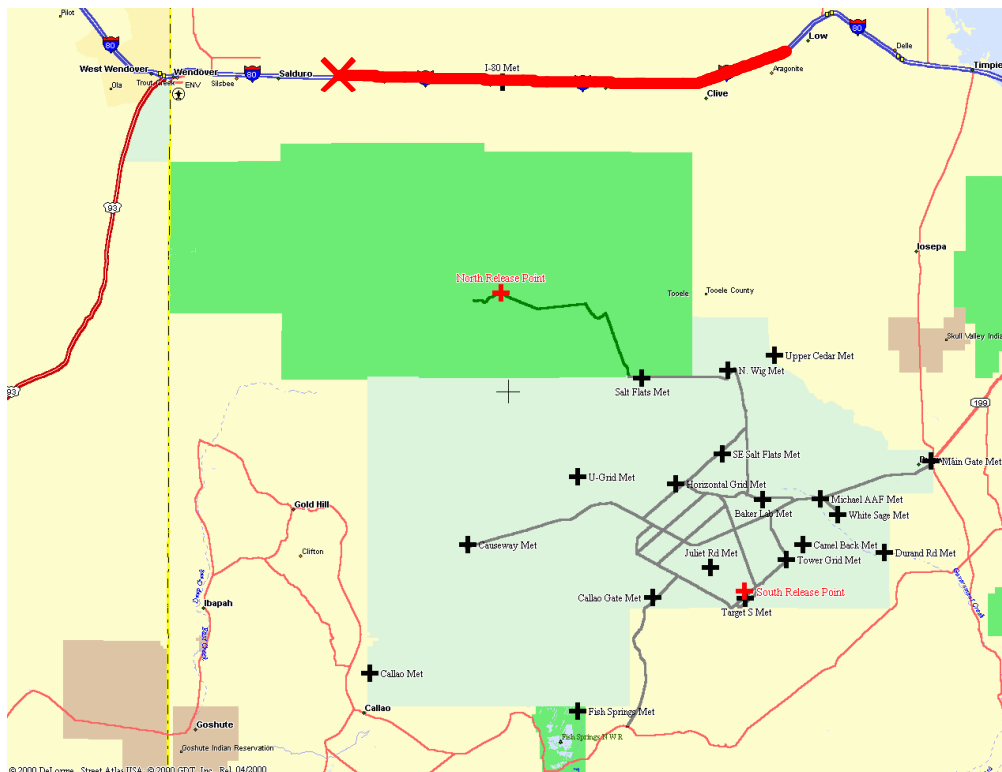
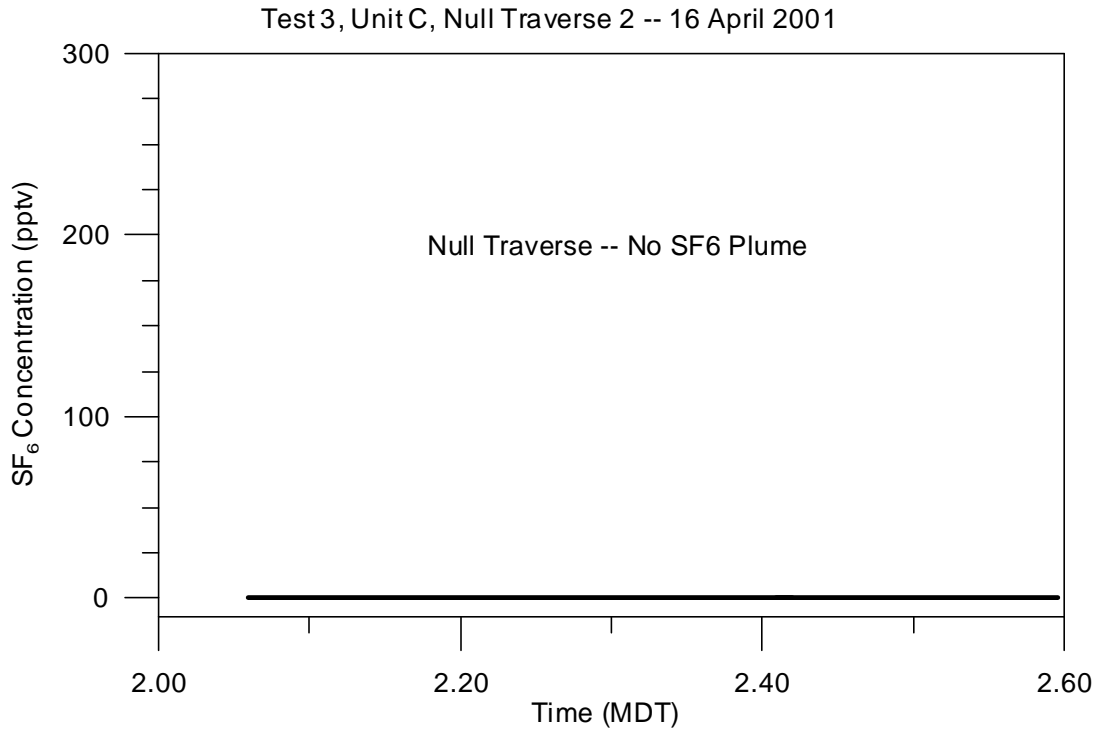


Figure A-112. Null sampling traverse 2 made by Sampling Unit C during Test 3, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

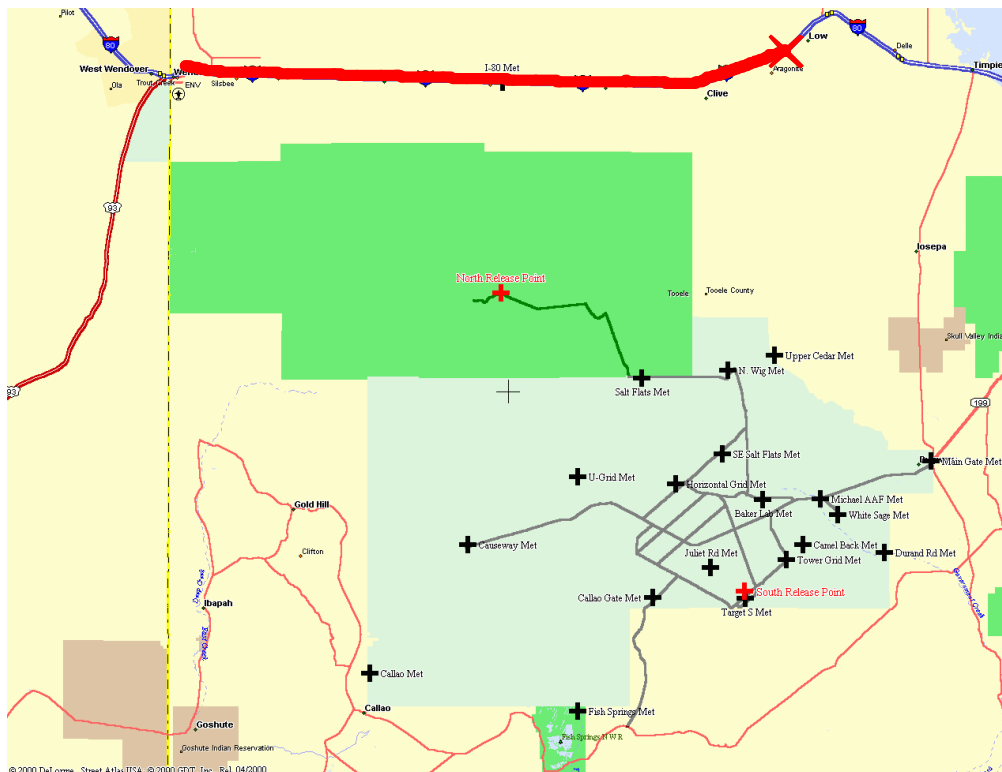
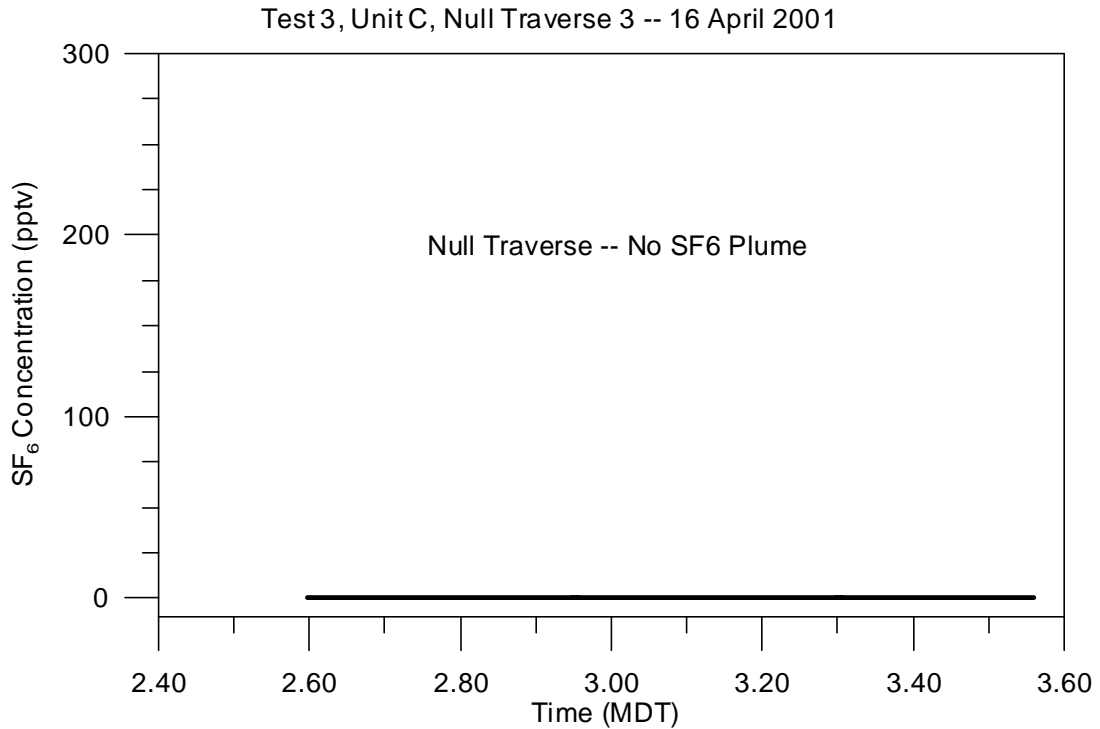


Figure A-113. Null sampling traverse 3 made by Sampling Unit C during Test 3, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

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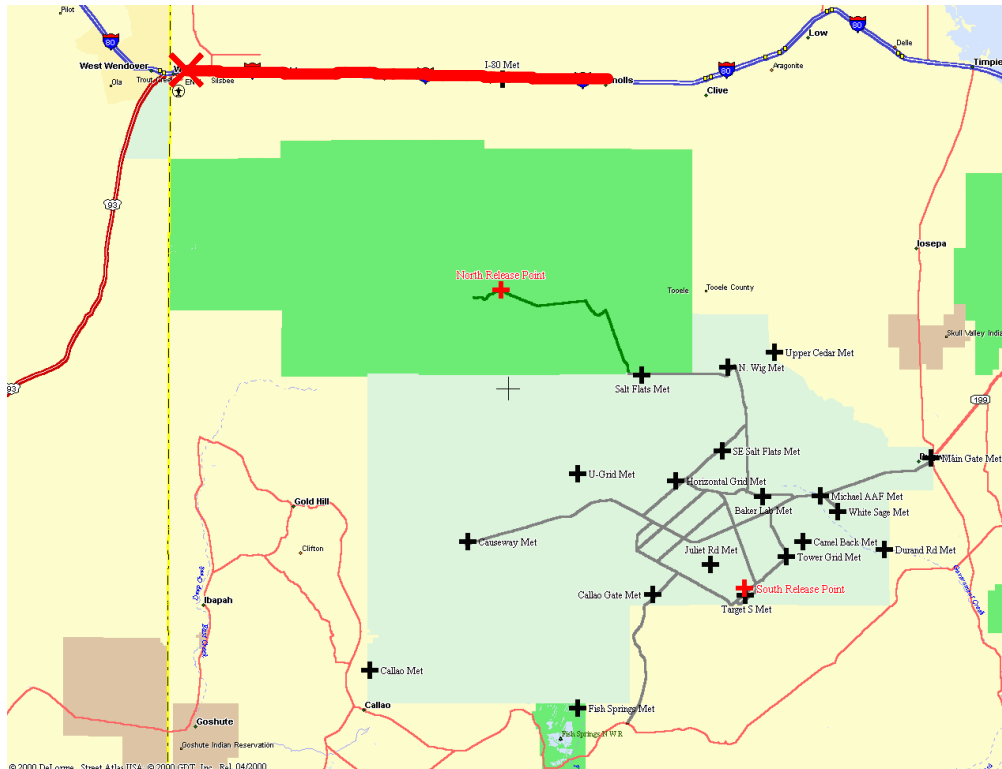
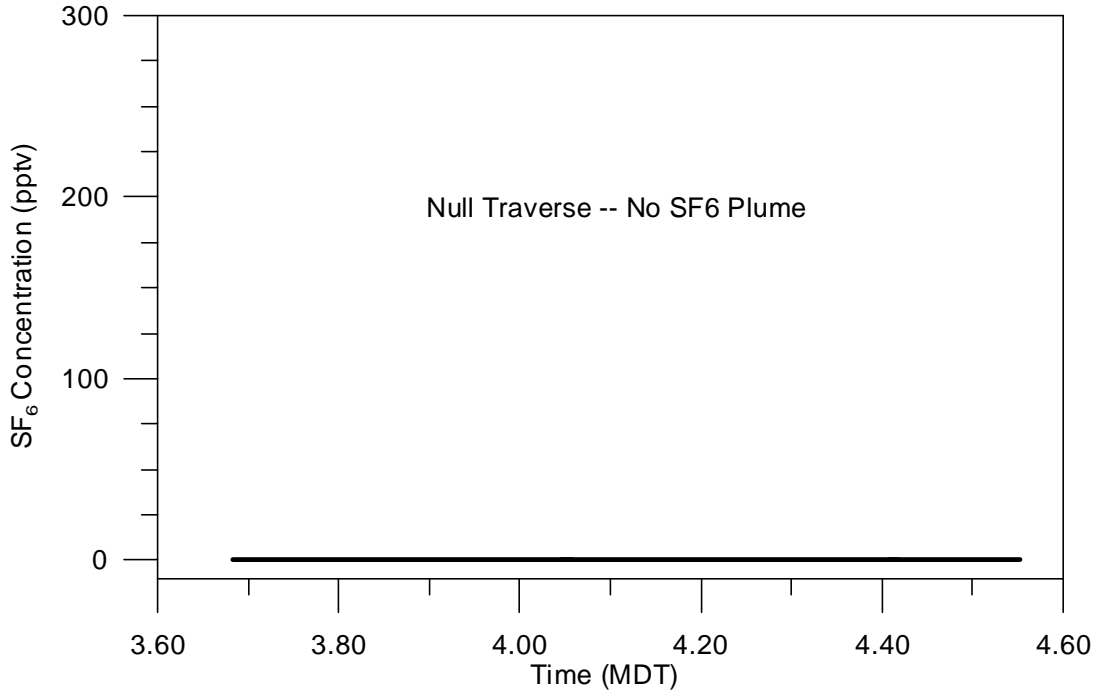


Figure A-114. Null sampling traverse 4 made by Sampling Unit C during Test 3, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

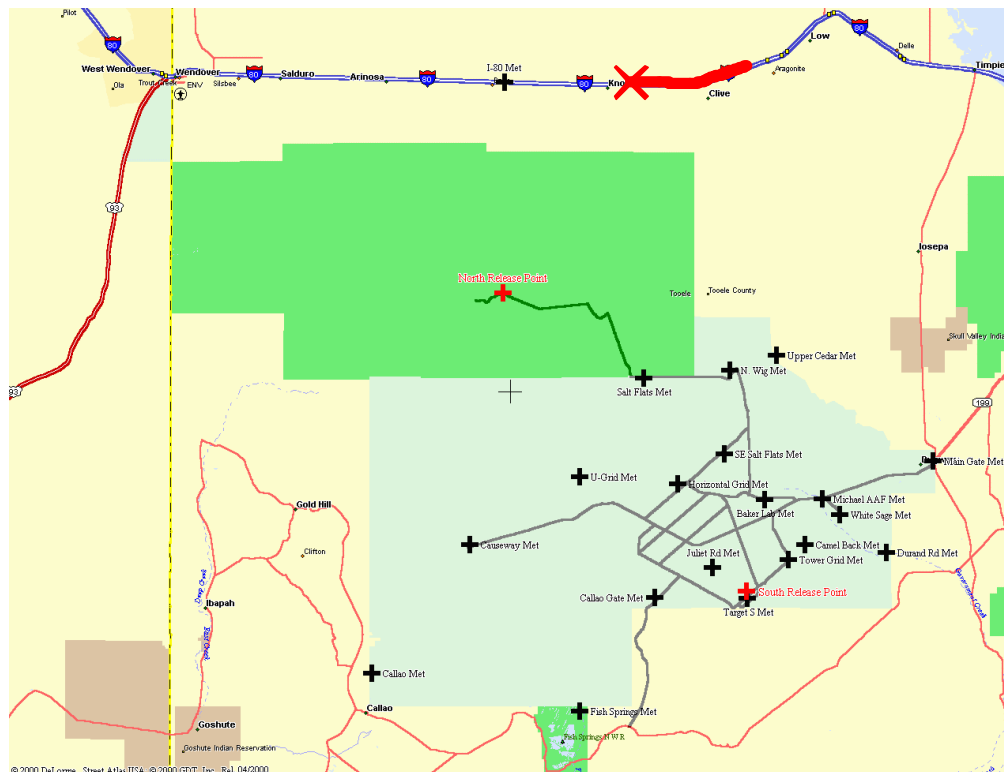
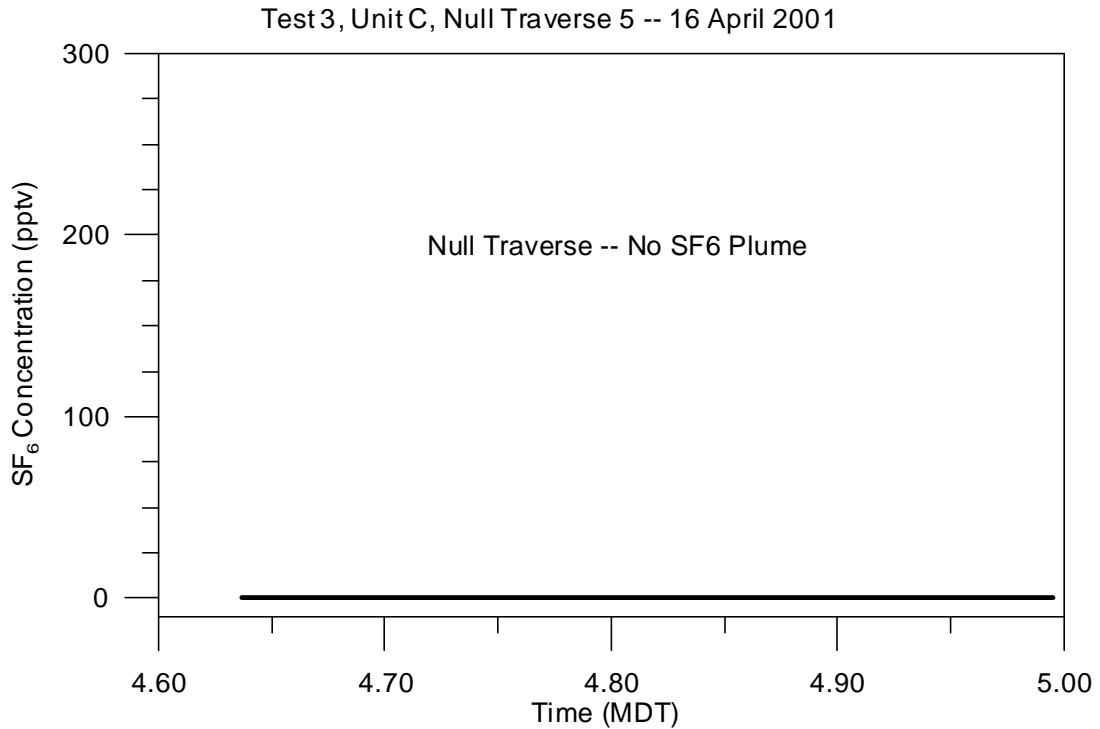


Figure A-115. Null sampling traverse 5 made by Sampling Unit C during Test 3, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

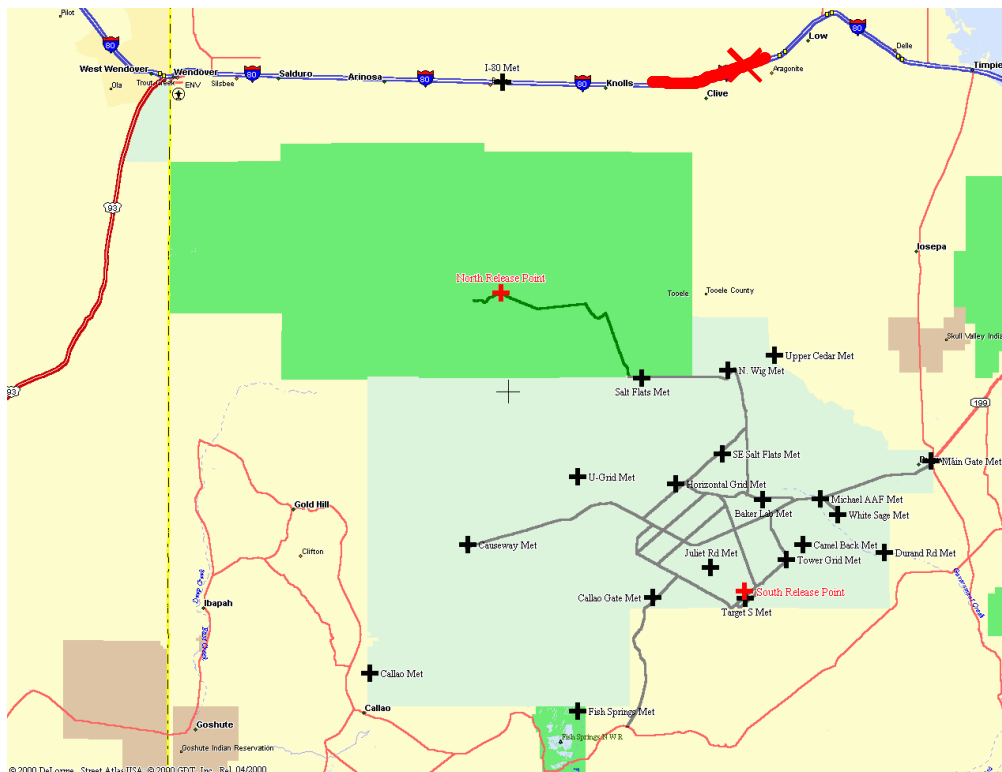
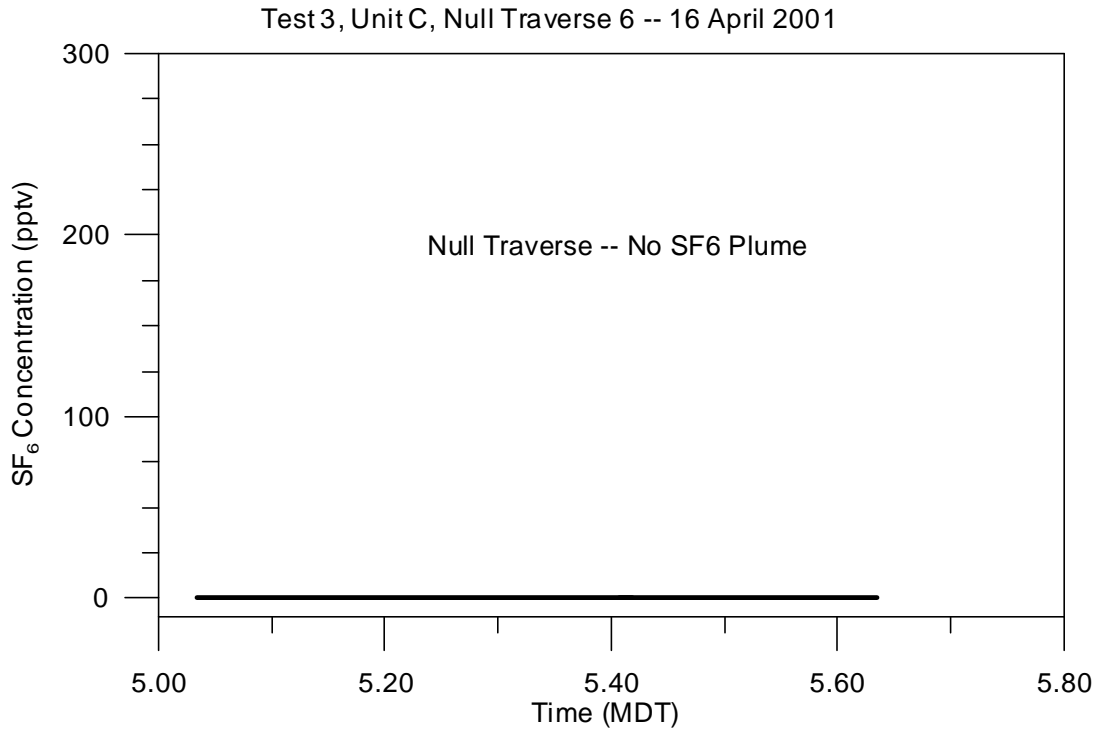


Figure A-116. Null sampling traverse 6 made by Sampling Unit C during Test 3, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

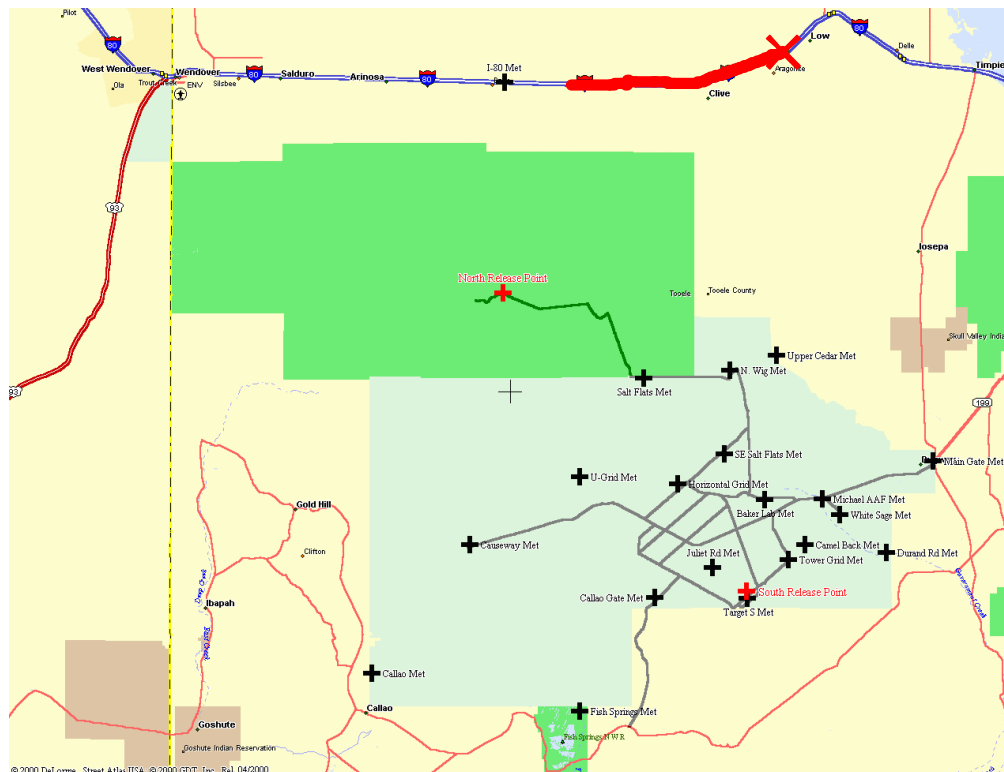
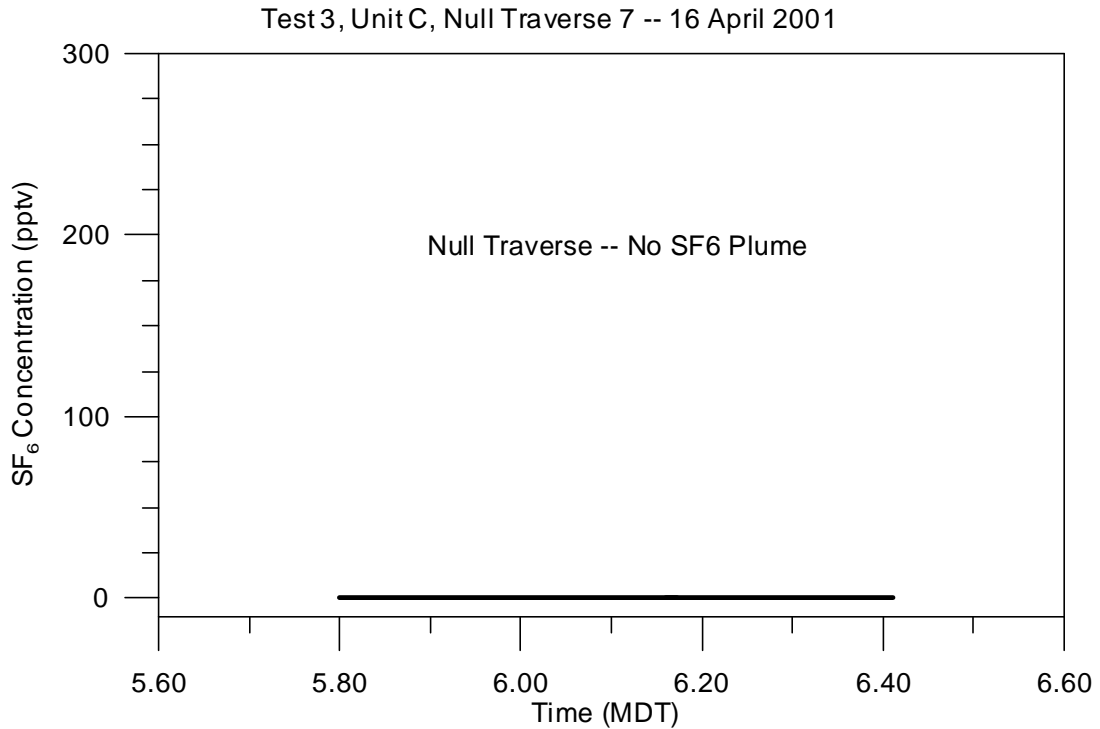


Figure A-117. Null sampling traverse 7 made by Sampling Unit C during Test 3, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

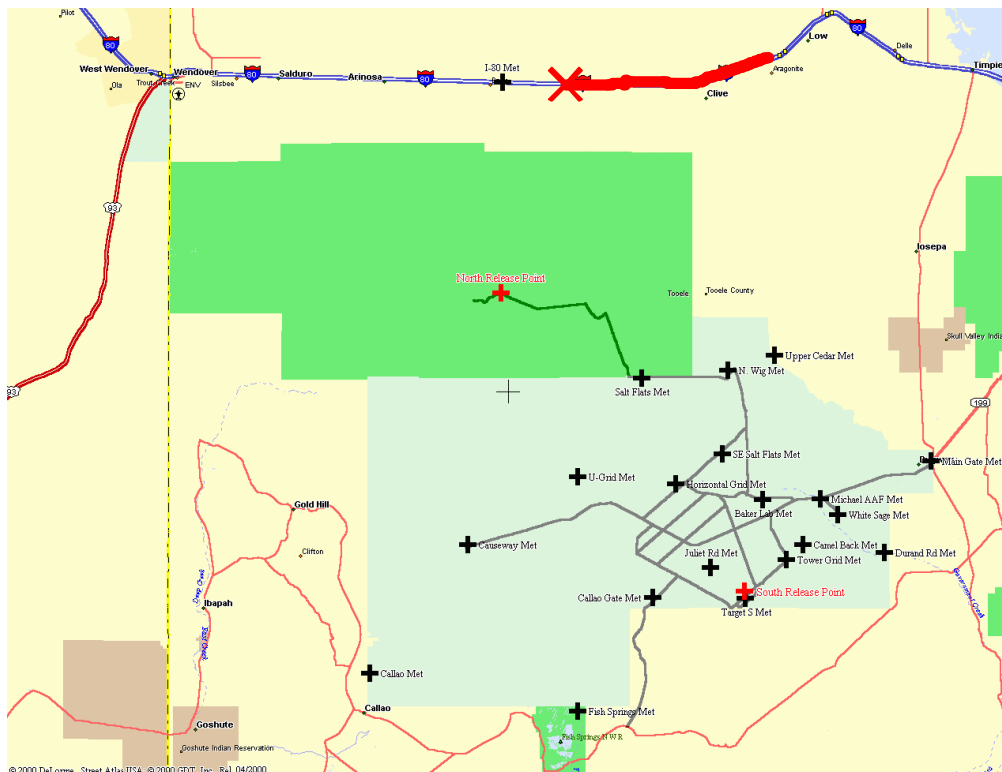
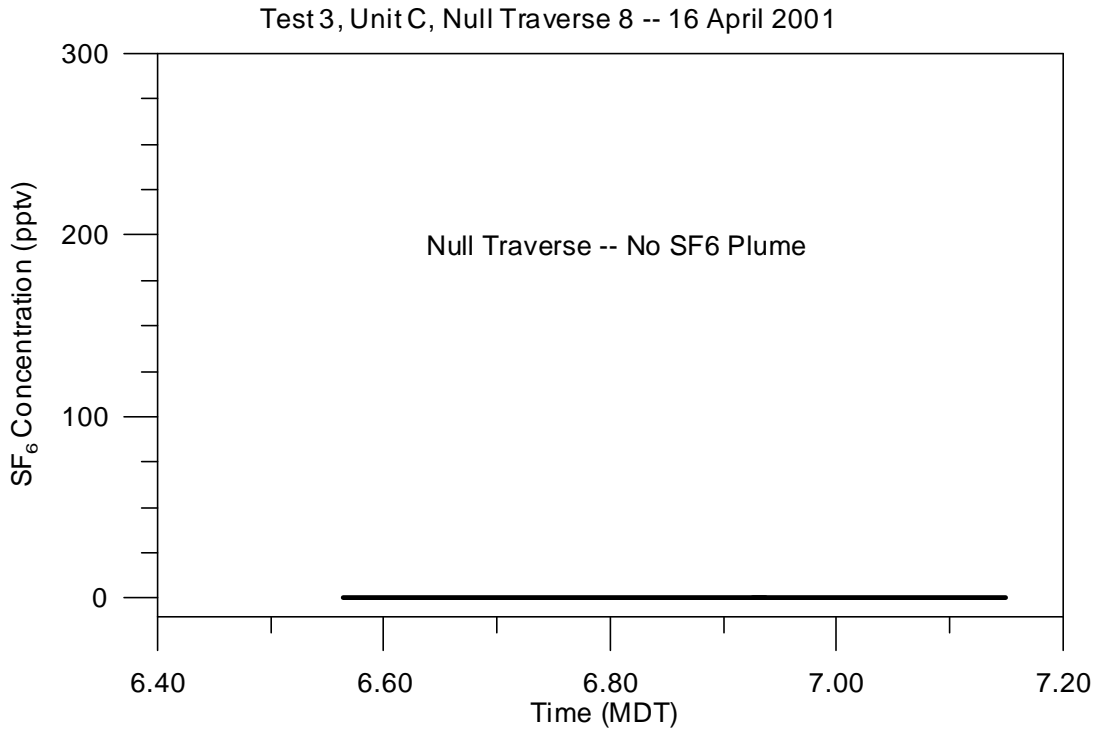


Figure A-118. Null sampling traverse 8 made by Sampling Unit C during Test 3, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

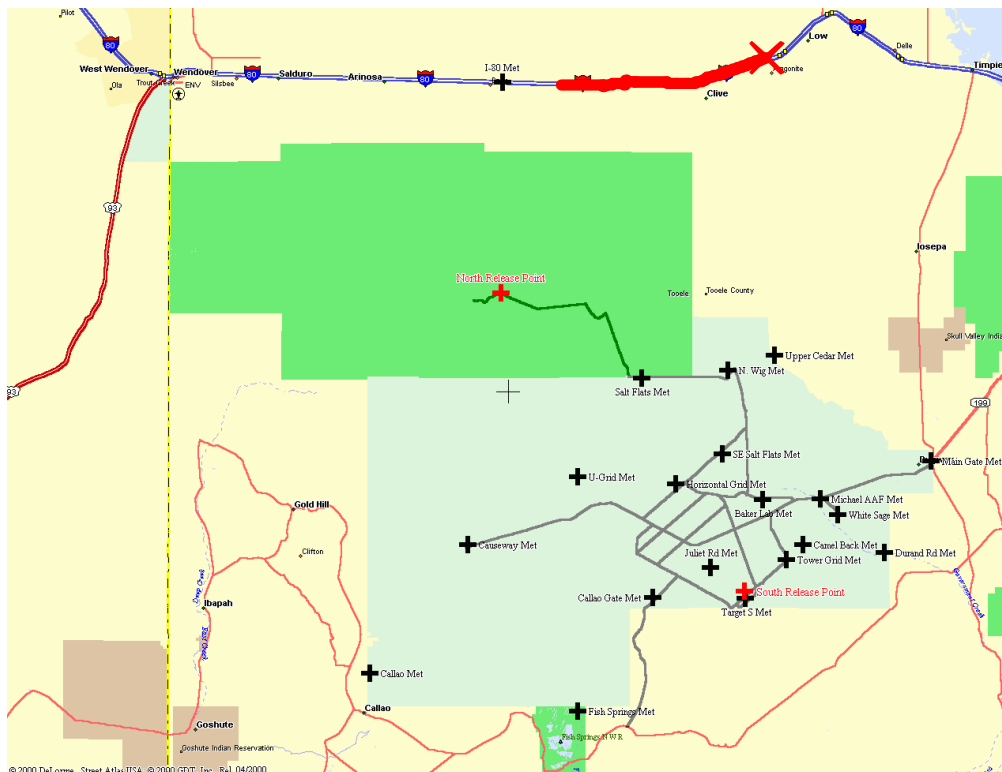
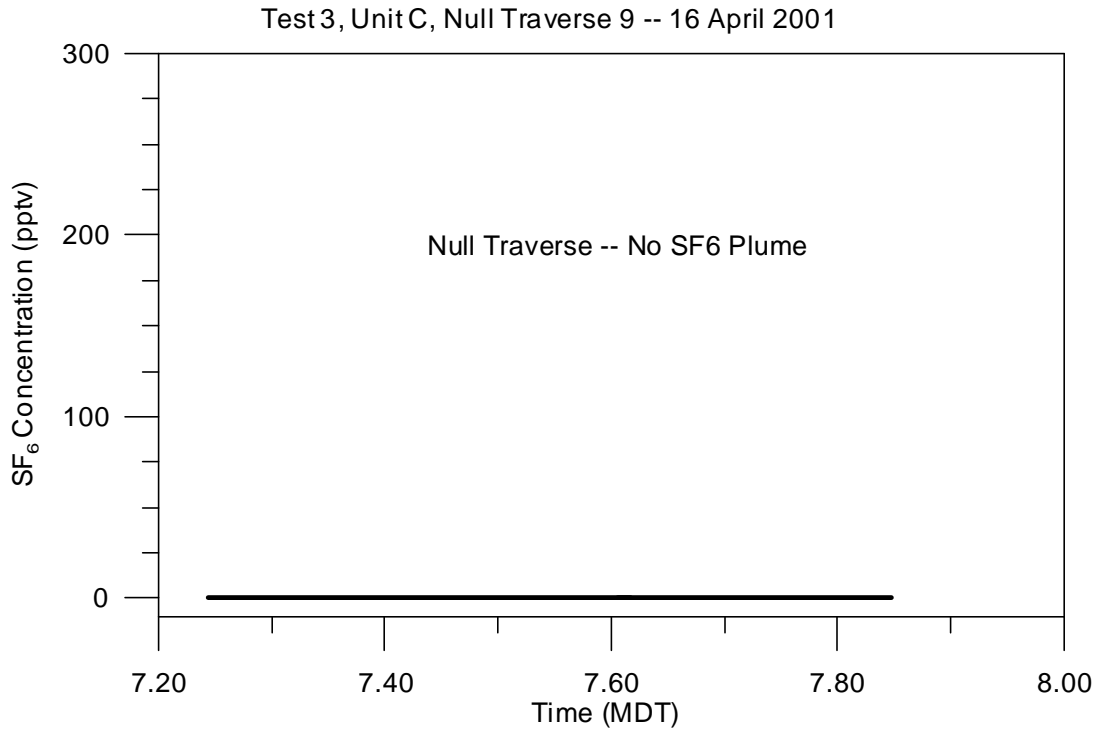


Figure A-119. Null sampling traverse 9 made by Sampling Unit C during Test 3, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 4
Sampling Unit A

Table A-29. Test 4 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	23:38	23:53
2	23:56	24:02

Table A-30. Summary of individual SF₆ plume characteristics measured by Sampling Unit A during Test 4. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time* (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	24:12-24:20	963	302.0-310.0	16.73	17.68	18.43
2	24:26-24:30	427	302.9-305.9	16.73	17.17	18.43
3	24:36-24:39	381	305.1-306.1	16.73	17.67	18.43
4	24:43-24:56	1543	304.0-324.6	16.25	16.40	16.87
5	25:14-25:39	2961	295.9-324.6	16.73	18.00	18.65
6	25:52-26:05	1601	292.6-314.4	14.71	15.41	16.41
7	26:05-26:15	1143	314.4-339.1	14.66	14.95	15.57
8	26:15-26:53	4560	289.3-339.2	14.65	15.51	16.94
9	27:03-27:30	3297	289.2-338.0	14.65	15.45	16.96
10	27:34-28:03	3432	289.2-338.1	14.65	15.31	16.96
11	28:07-28:46	4758	289.2-357.5	13.94	15.31	16.95
12	29:54-30:30	4390	284.7-313.6	11.42	15.26	16.96
13	30:40-31:11	3717	283.5-308.7	10.57	14.78	16.94
14	31:22-31:57	4235	286.7-324.0	14.66	21.68	32.49
15	32:08-32:24	1906	287.3-306.7	18.32	25.09	31.91

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

Table A-31. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit A during Test 4.

Plume Number	Concentration (pptv)	Time* (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	86.6	24:17	40.148750	113.214495	305.7	17.15
2	164.6	24:28	40.146952	113.210138	305.9	16.74
3	16.6	24:38	40.149868	113.217148	305.6	17.41
4	5028.3	24:47	40.155313	113.197263	310.7	16.45
5	2148.3	25:20	40.165882	113.210170	311.3	18.05
6	663.9	25:59	40.133298	113.201700	302.8	15.29
7	107.5	26:08	40.163452	113.155993	322.4	14.68
8	684.4	26:46	40.118037	113.224850	294.0	16.22
9	1263.8	27:21	40.150502	113.175615	313.8	14.72
10	975.4	27:49	40.146150	113.182183	311.0	14.81
11	488.1	28:21	40.135672	113.198075	304.3	15.17
12	420.3	30:25	40.094183	113.203292	286.9	13.57
13	377.3	30:44	40.088545	113.189825	285.7	12.29
14	256.5	31:49	40.167778	113.324958	297.4	26.32
15	180.4	32:14	40.162178	113.335313	295.4	26.83

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

Table A-32. Test 4 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) after the last SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
3	32:28	32:50

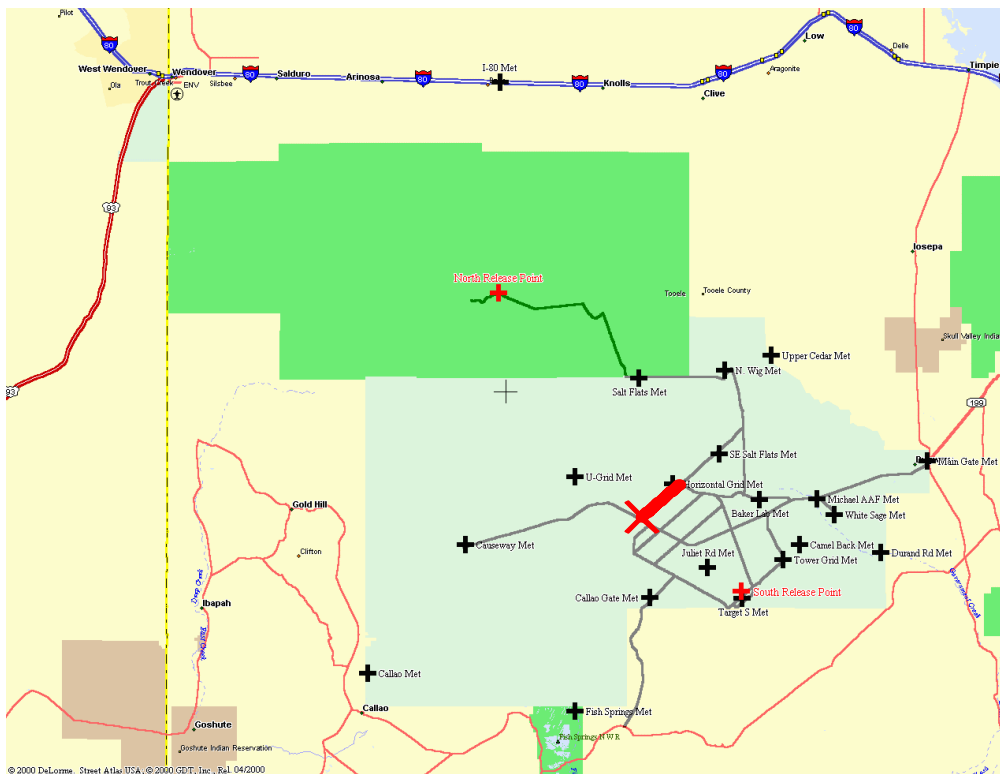
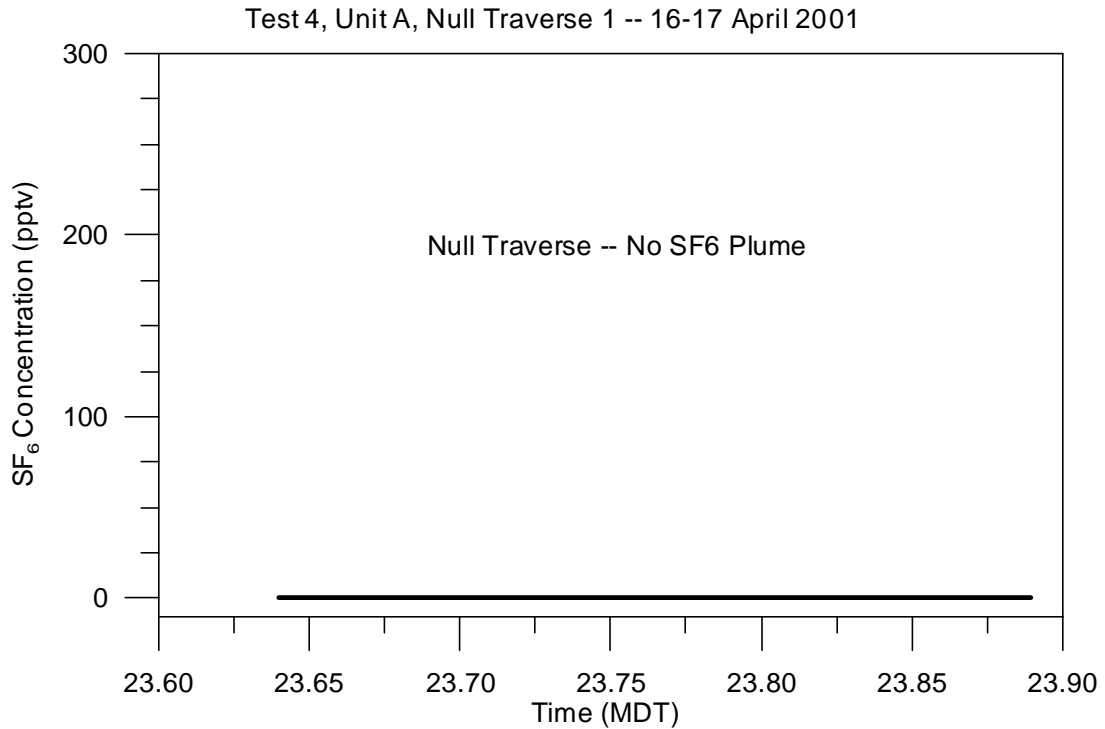


Figure A-120. Null sampling traverse 1 made by Sampling Unit A during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

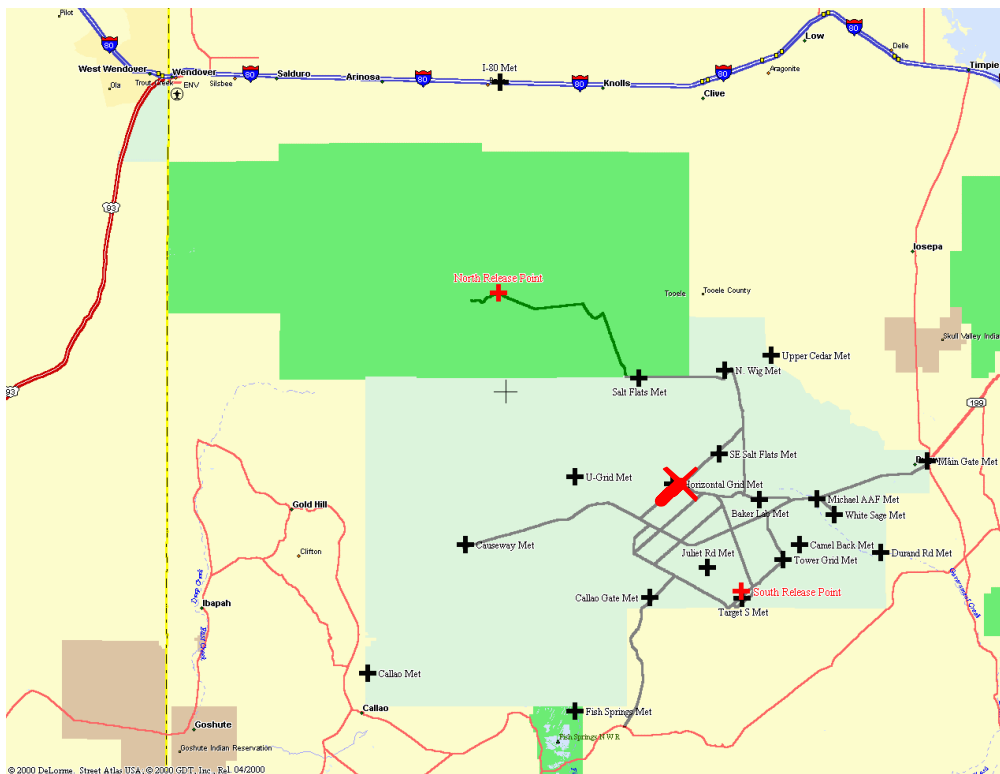
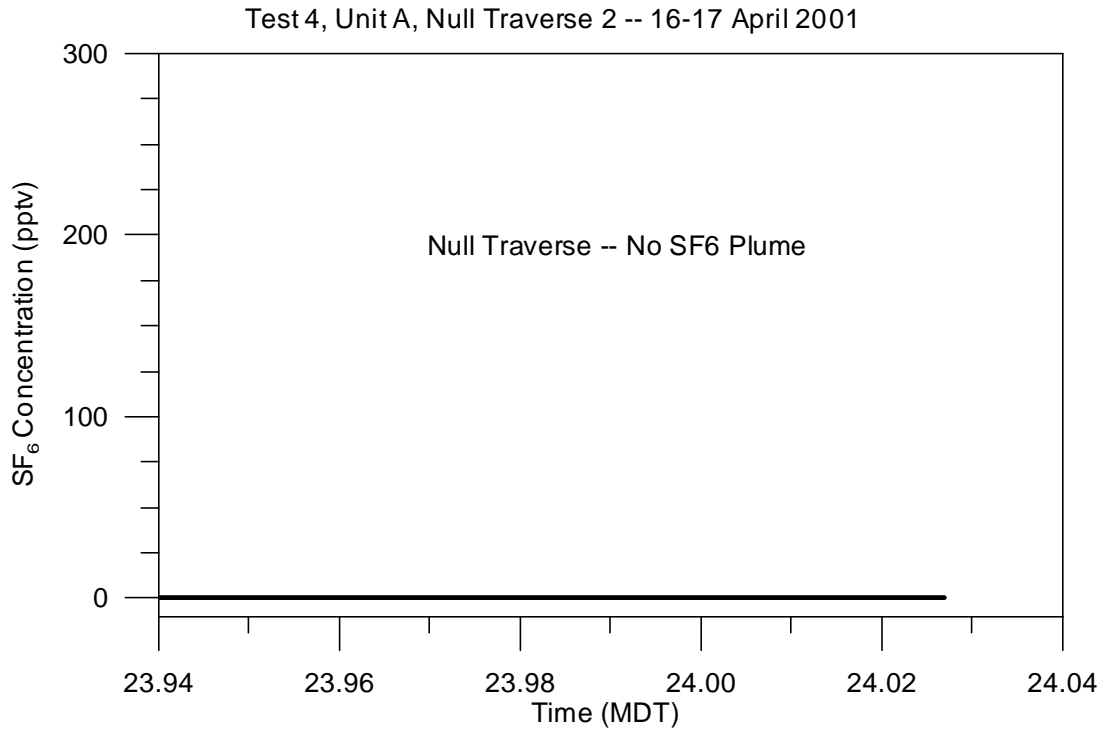


Figure A-121. Null sampling traverse 2 made by Sampling Unit A during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

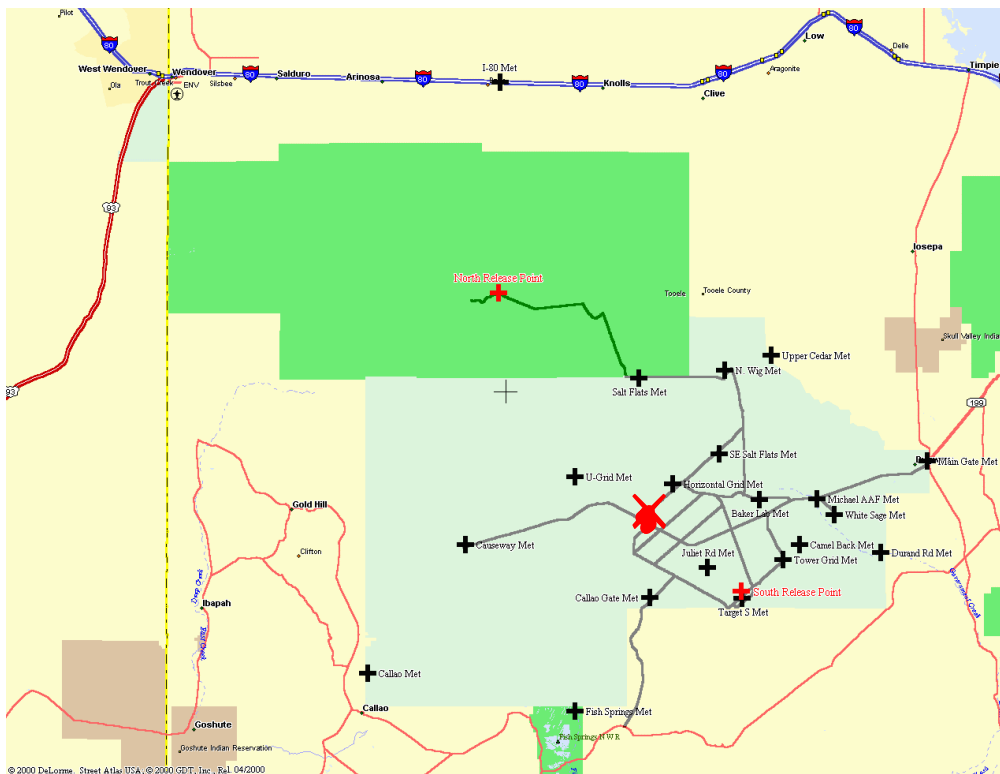
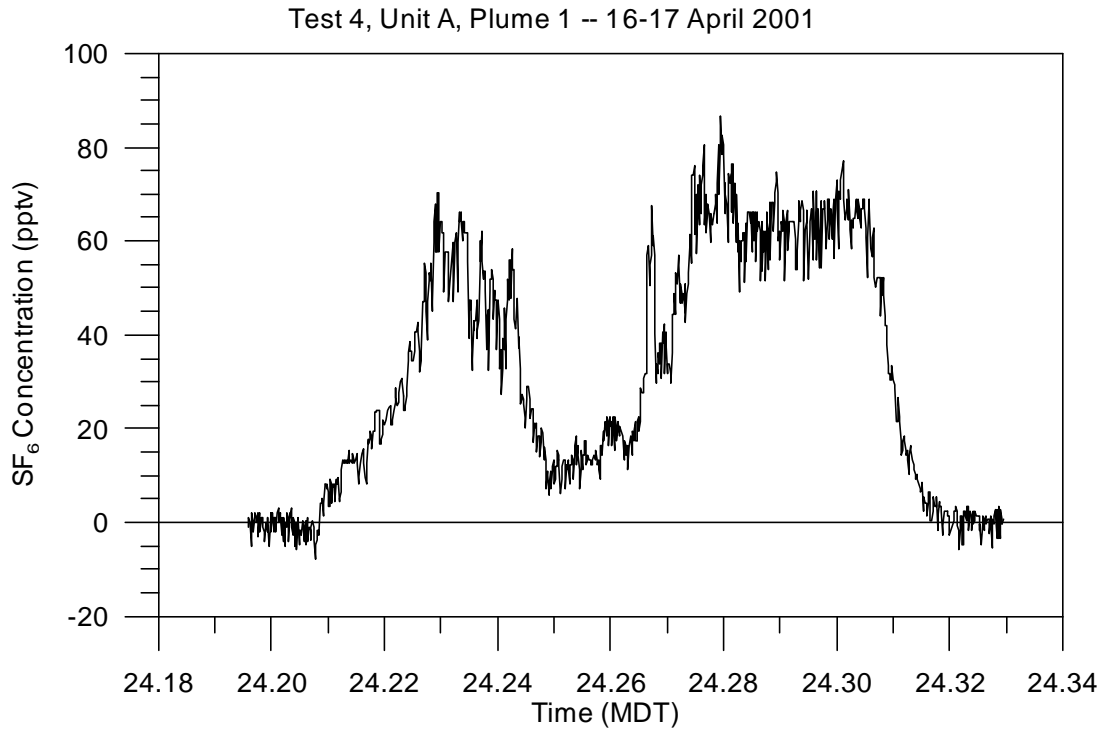


Figure A-122. SF₆ concentration of Plume 1 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

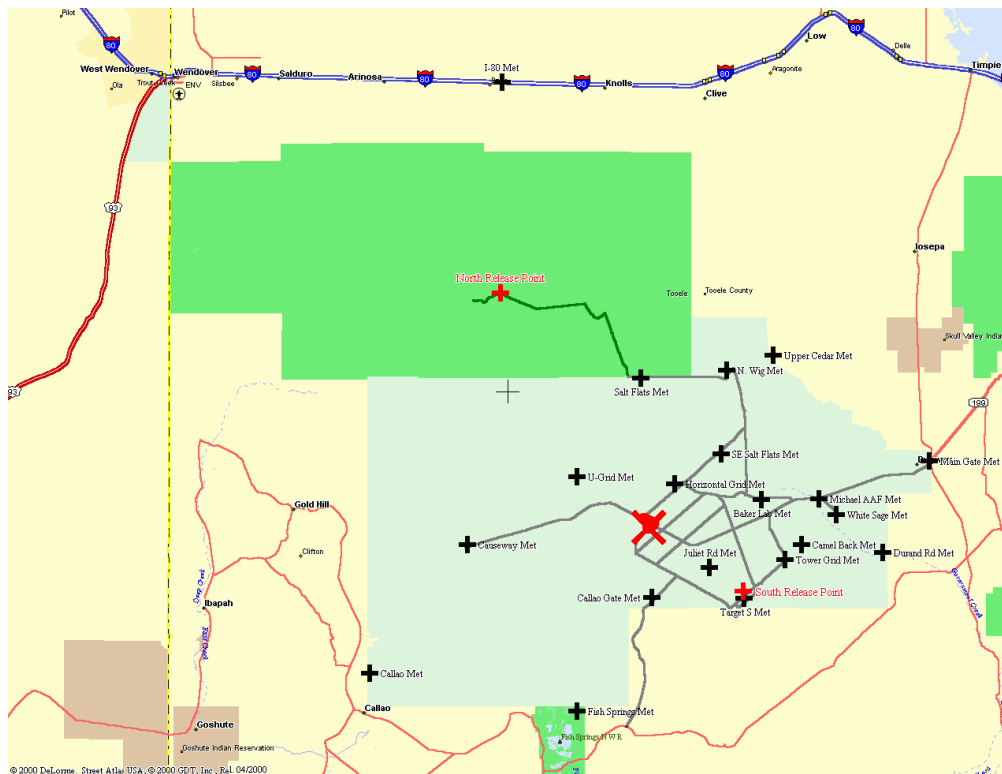
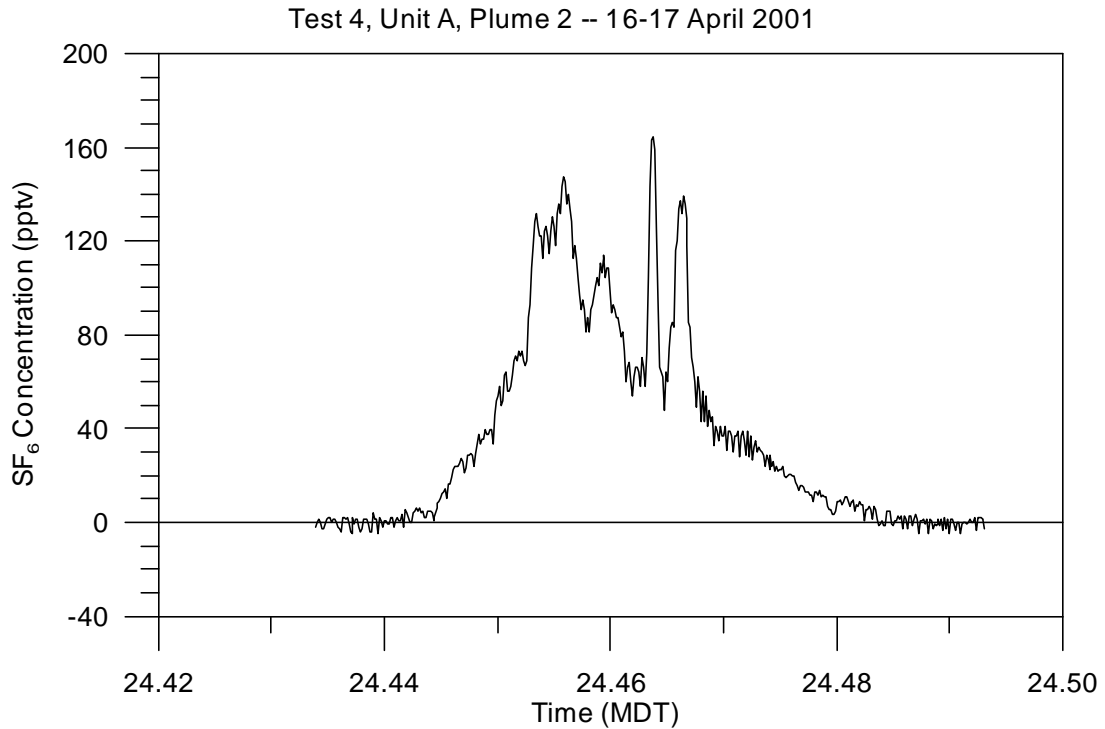


Figure A-123. SF₆ concentration of Plume 2 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

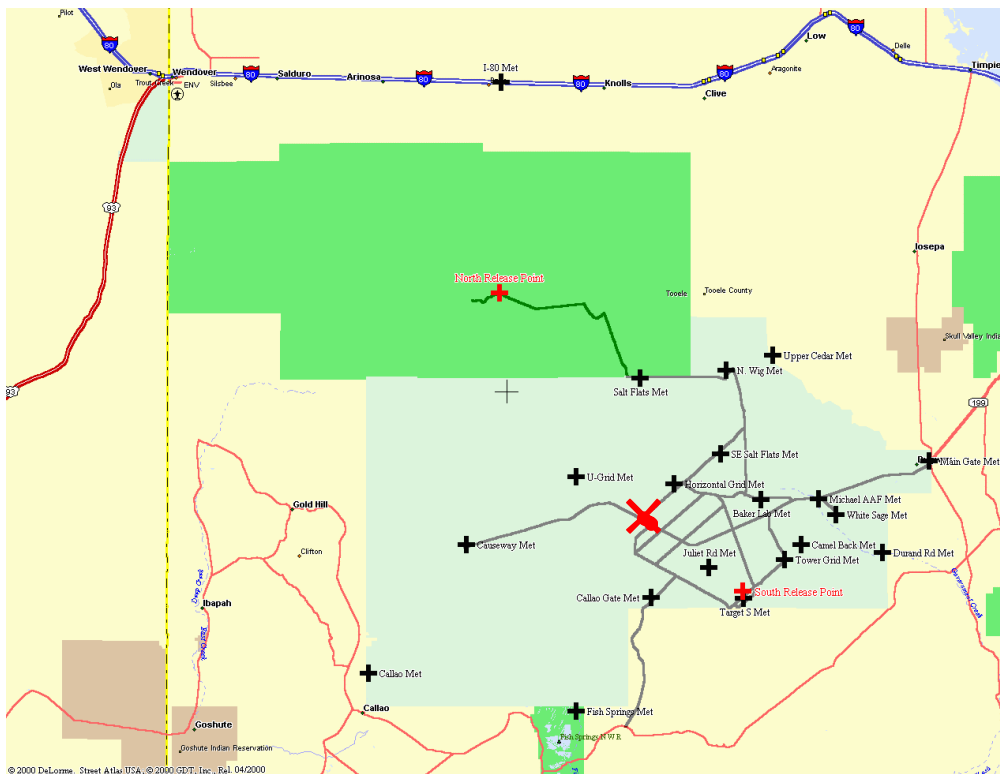
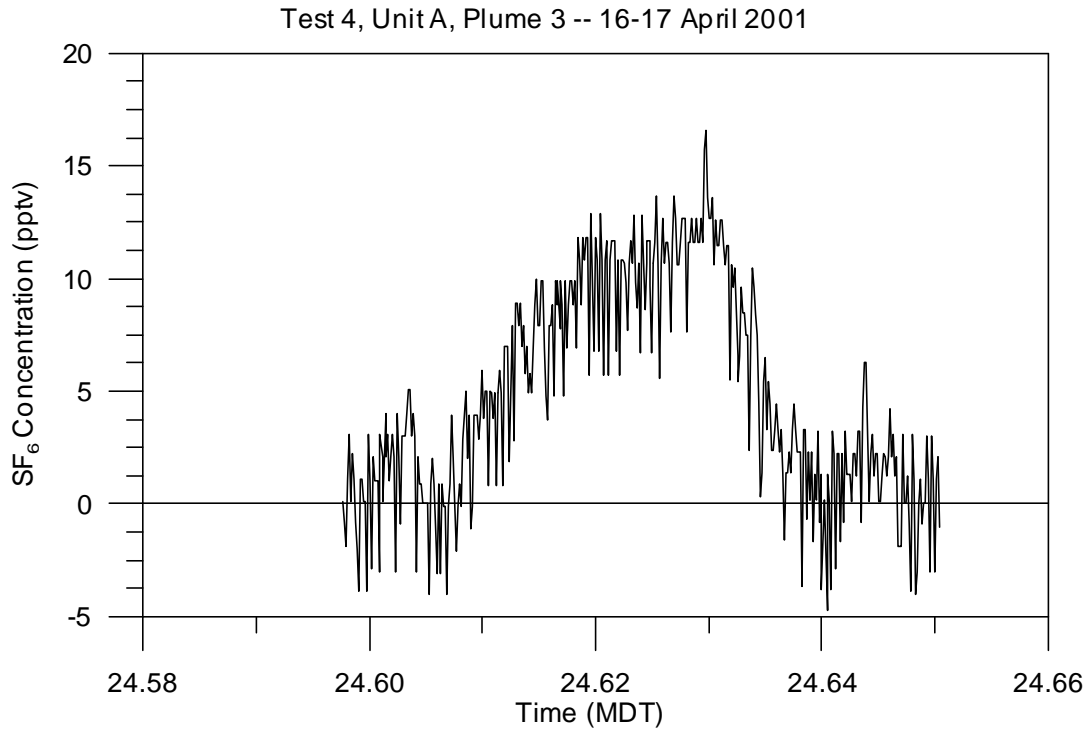


Figure A-124. SF₆ concentration of Plume 3 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

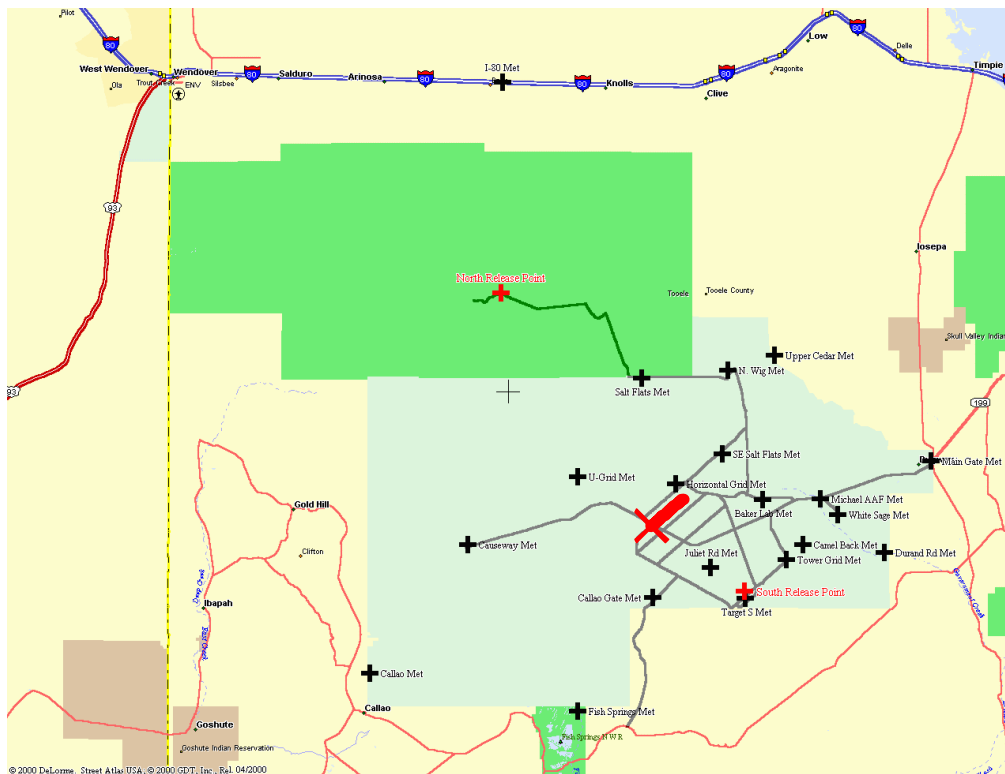
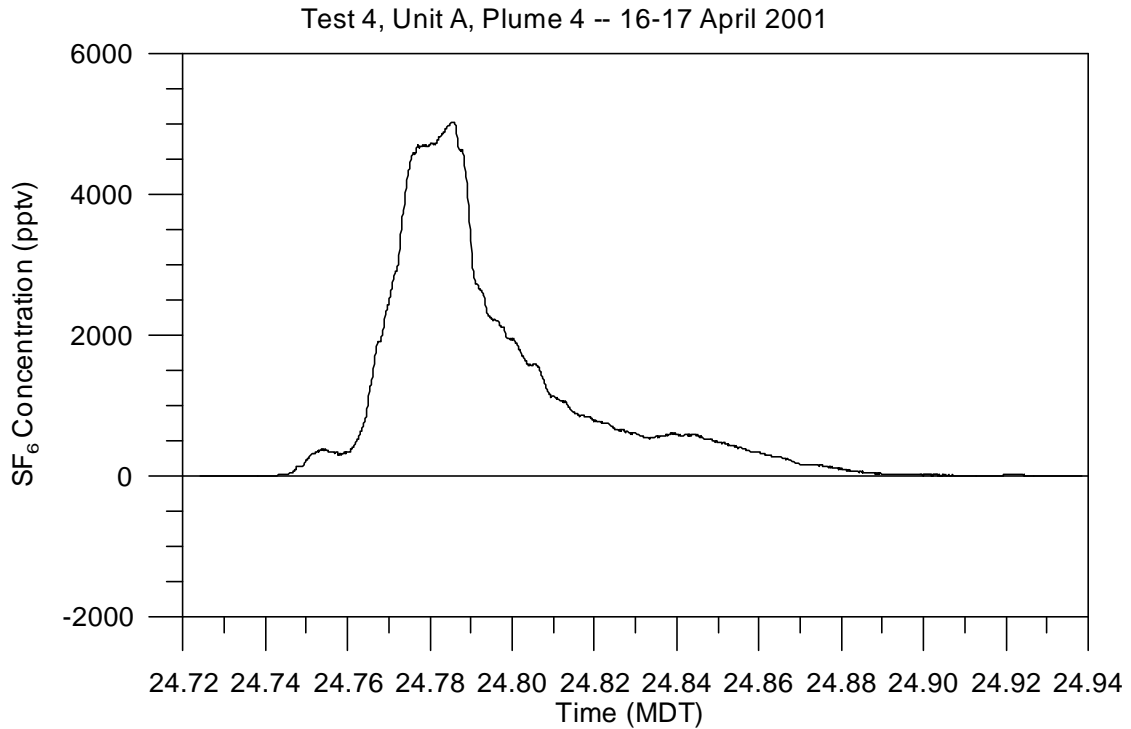


Figure A-125. SF₆ concentration of Plume 4 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

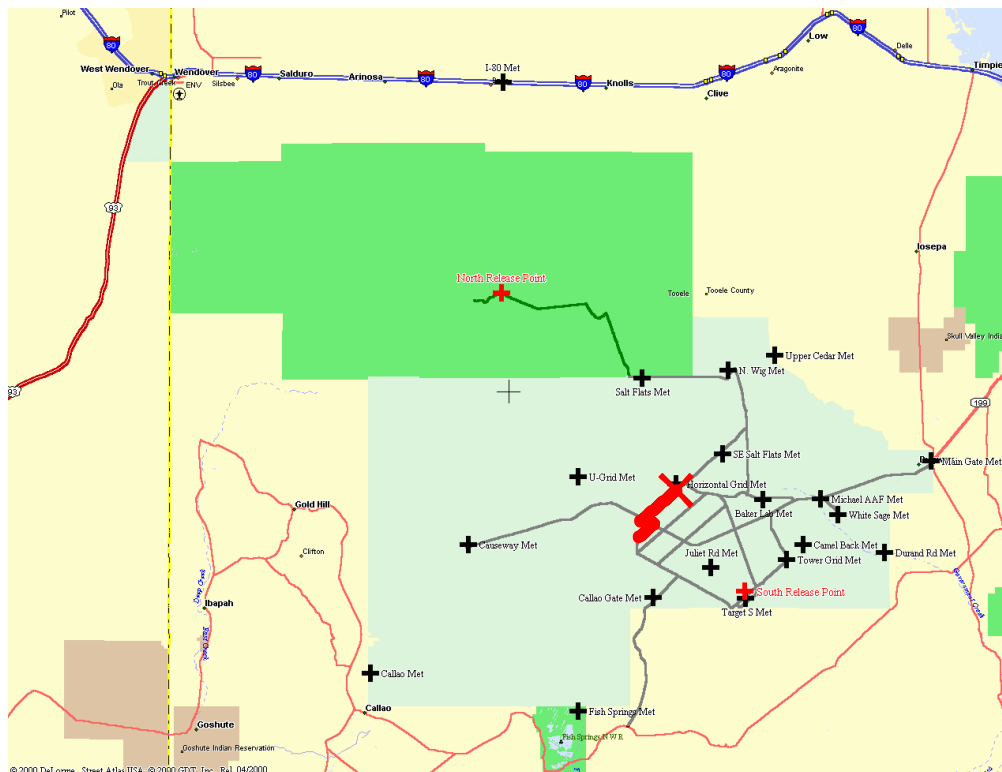
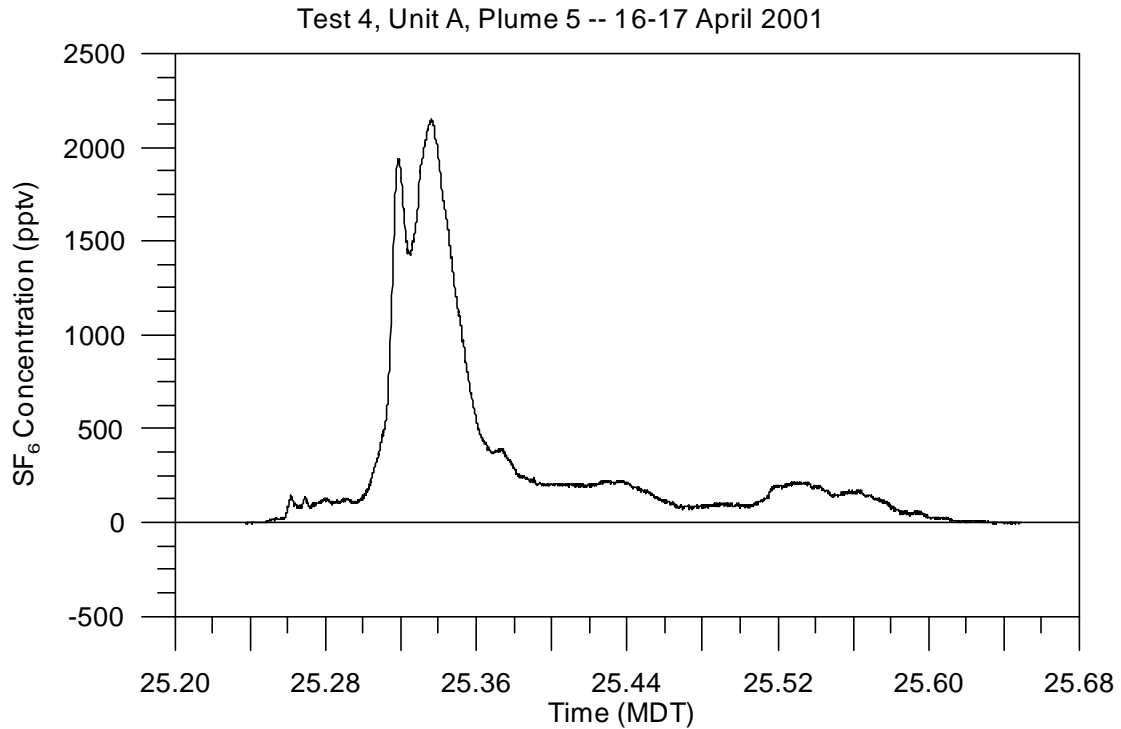


Figure A-126. SF₆ concentration of Plume 5 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

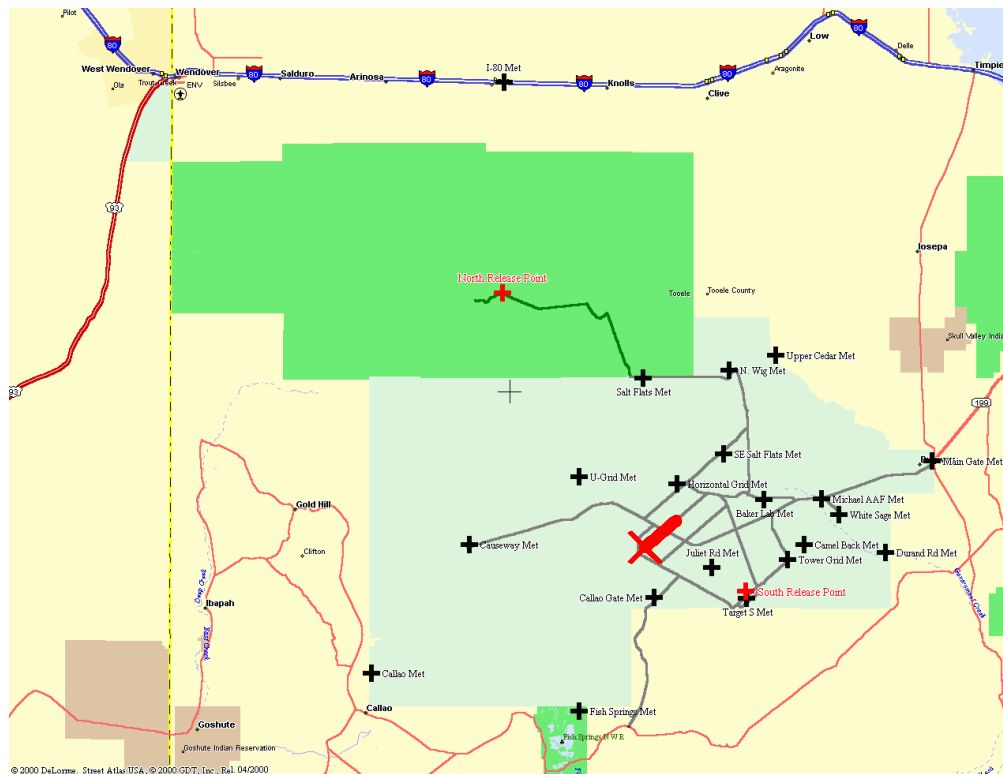
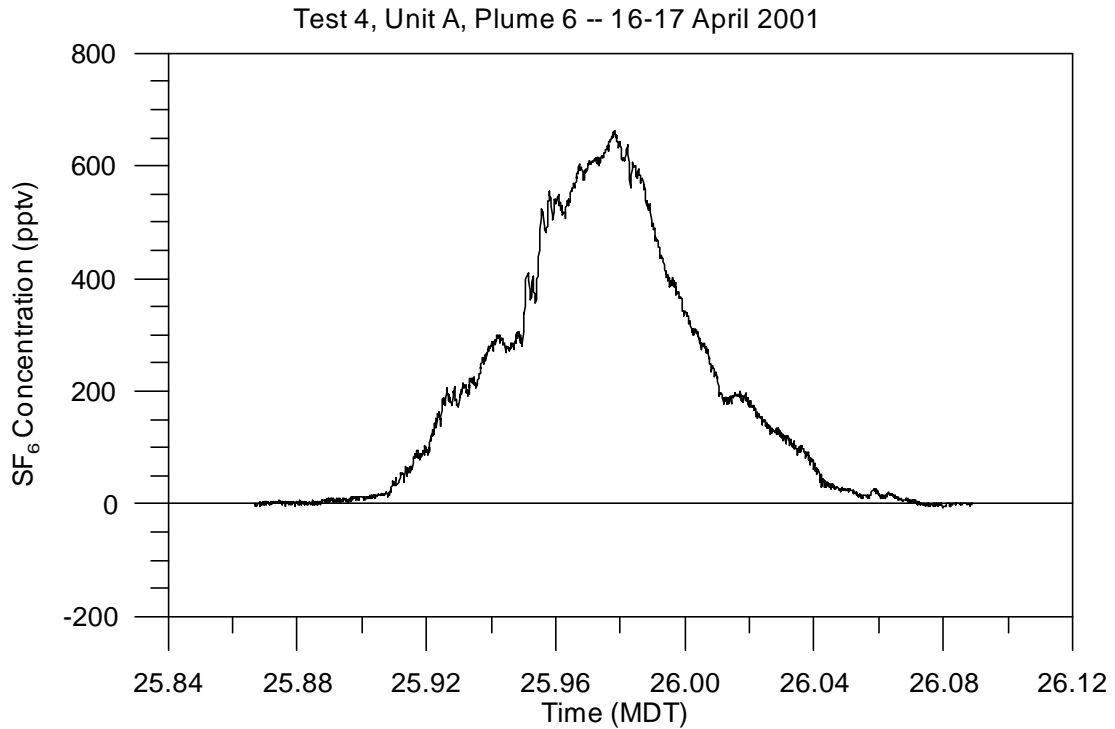


Figure A-127. SF₆ concentration of Plume 6 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

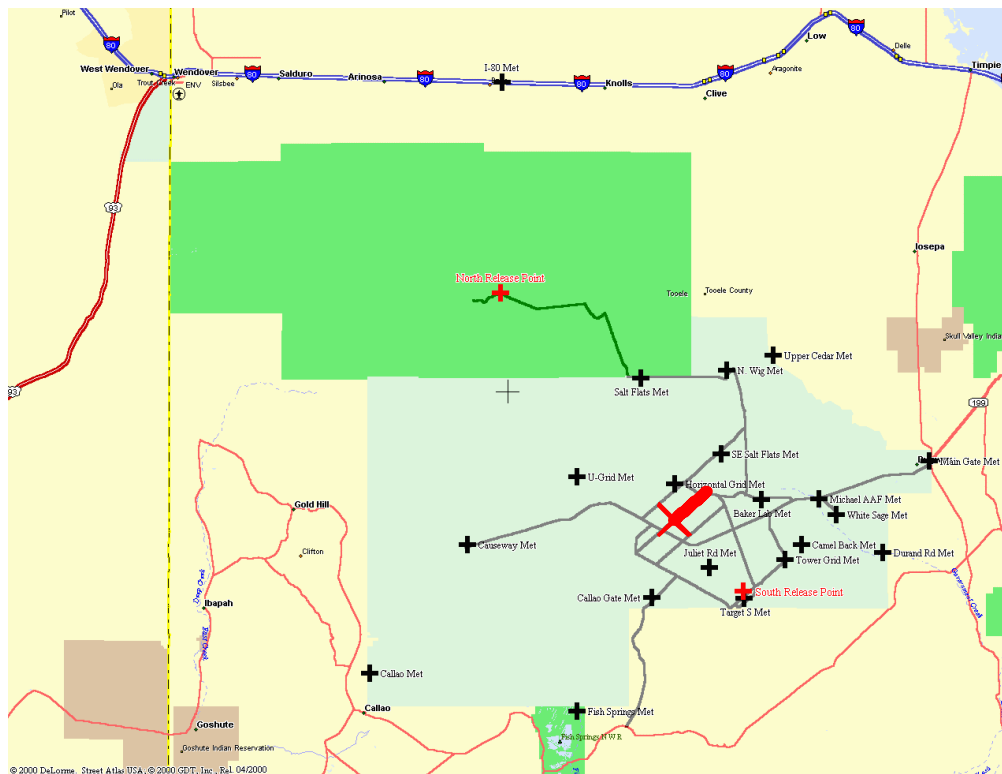
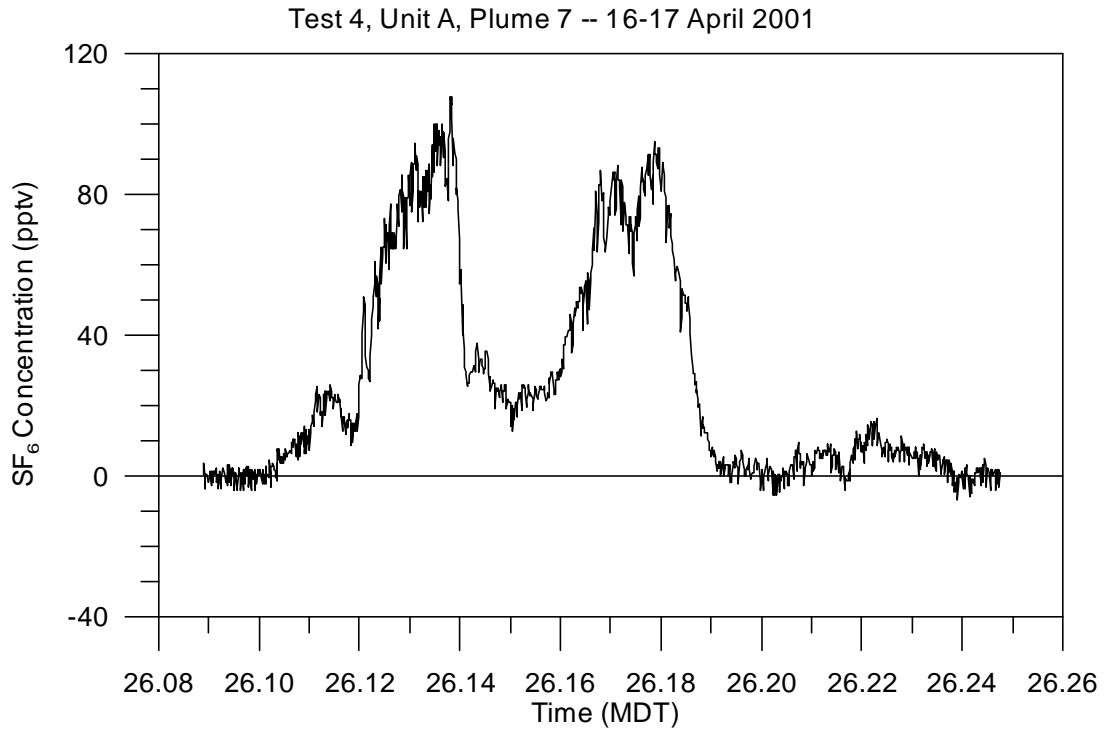


Figure A-128. SF₆ concentration of Plume 7 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

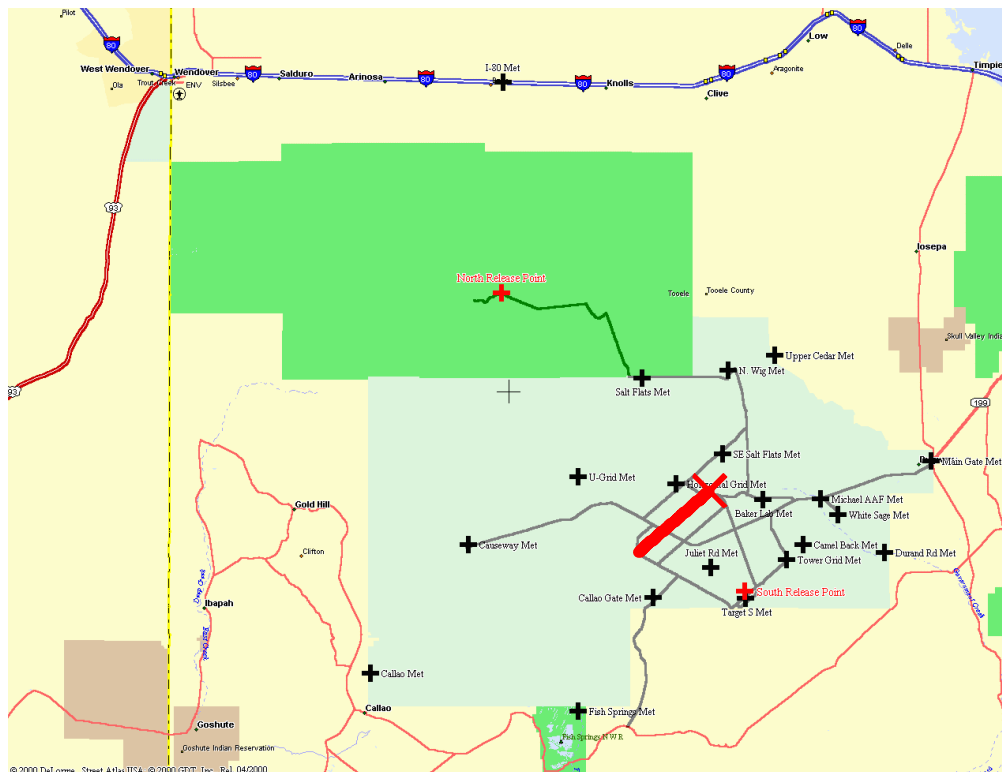
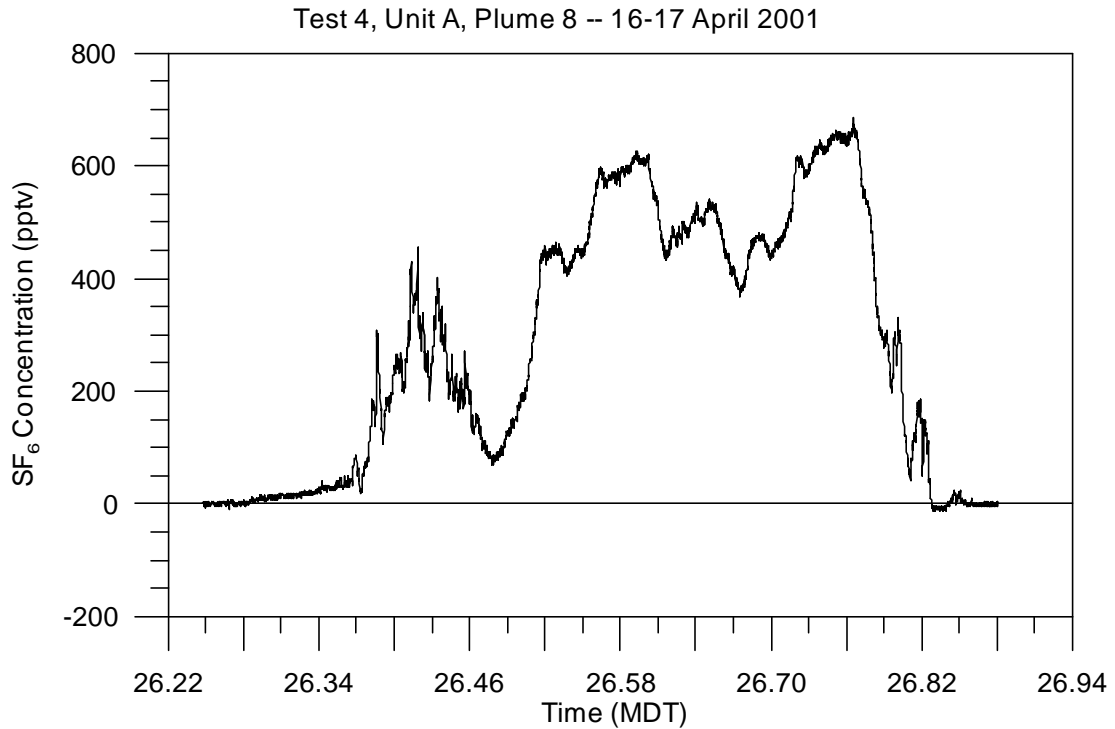


Figure A-129. SF₆ concentration of Plume 8 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

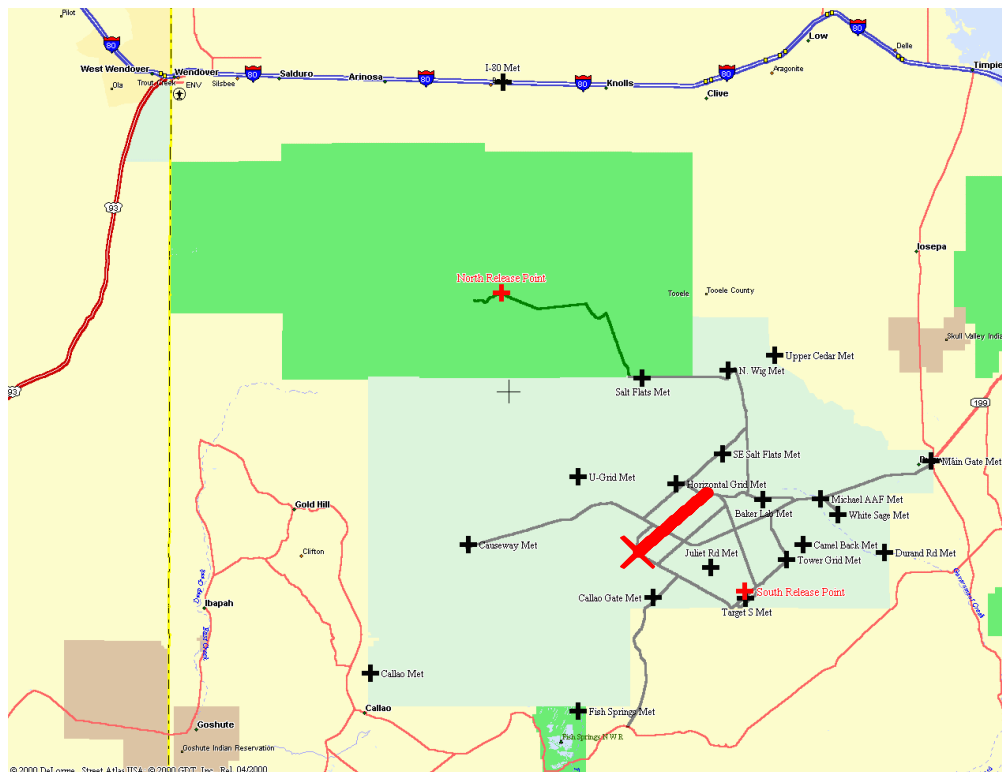
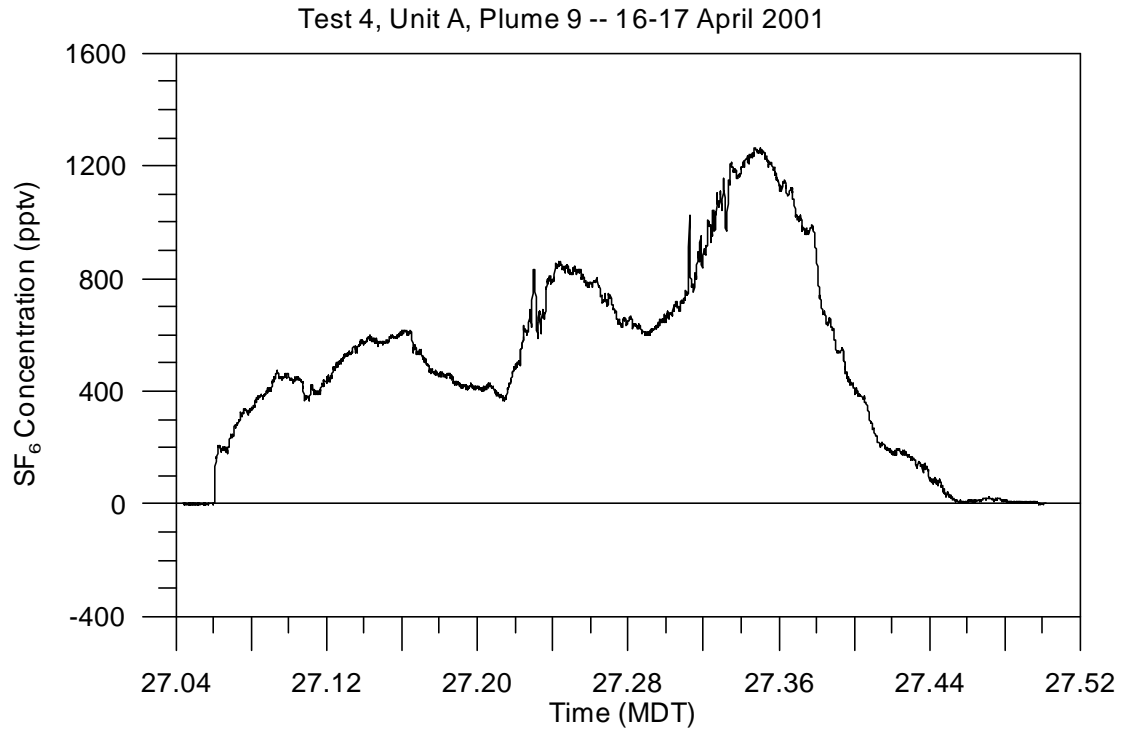


Figure A-130. SF₆ concentration of Plume 9 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

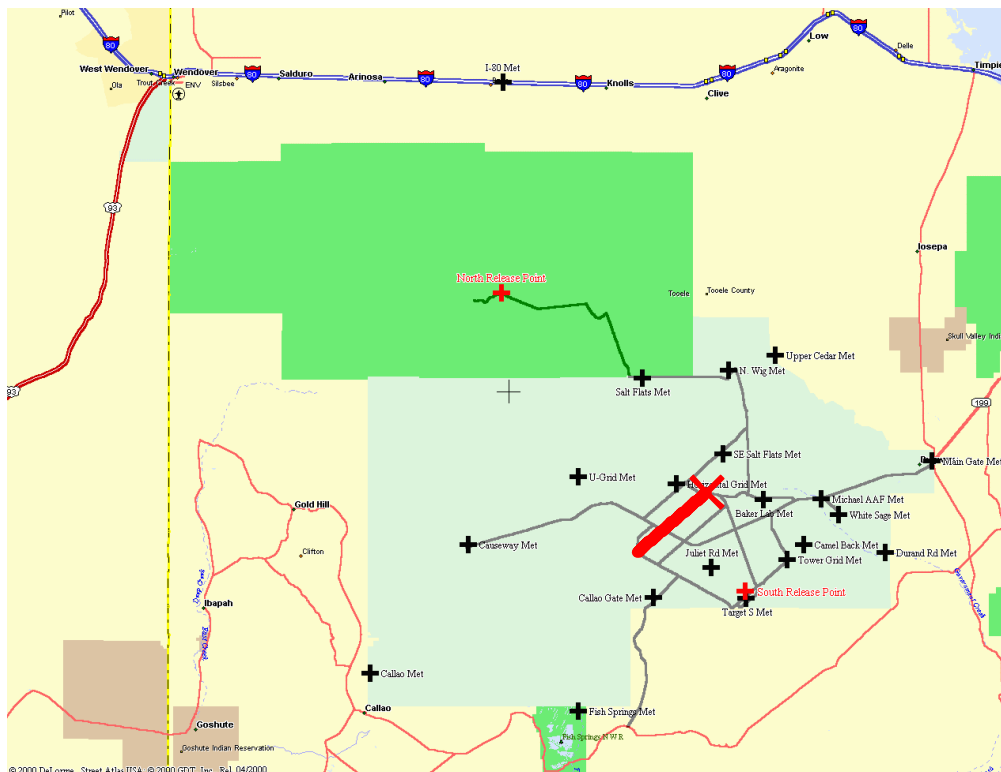
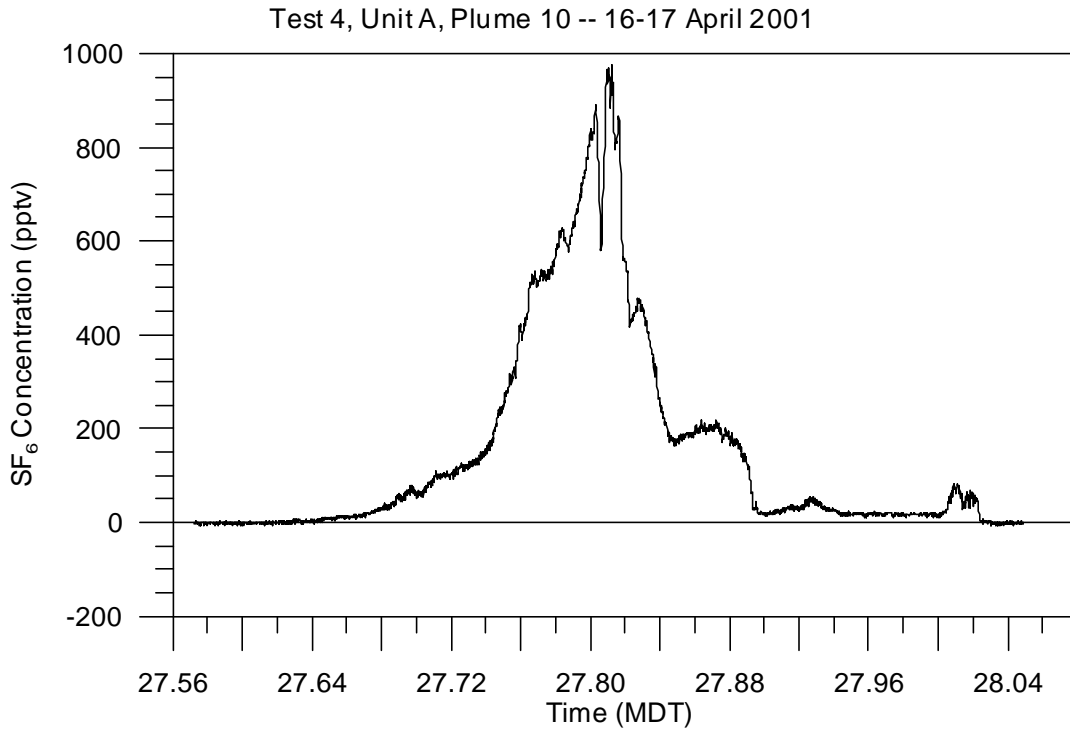


Figure A-131. SF₆ concentration of Plume 10 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

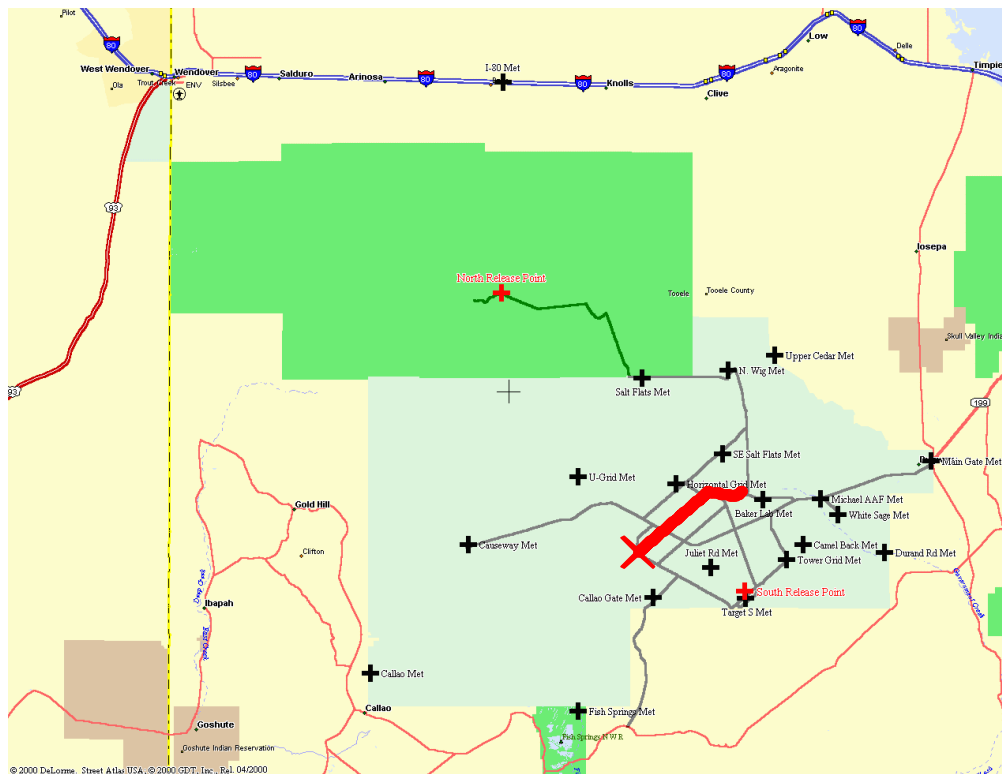
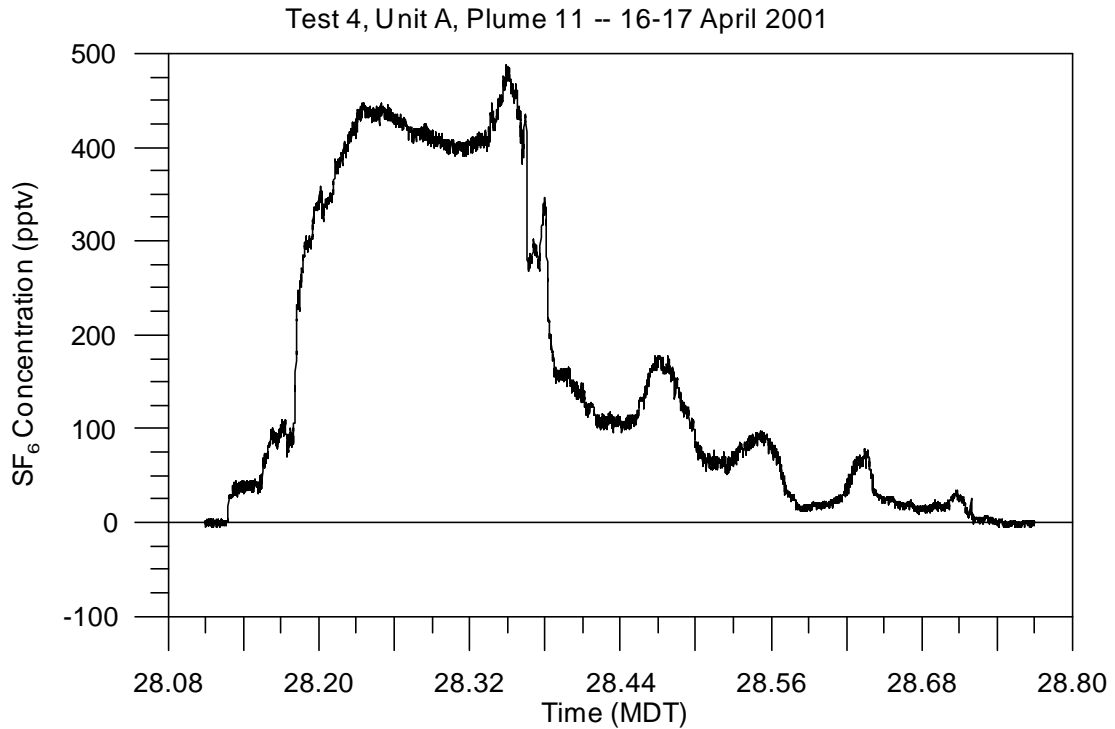


Figure A-132. SF₆ concentration of Plume 11 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

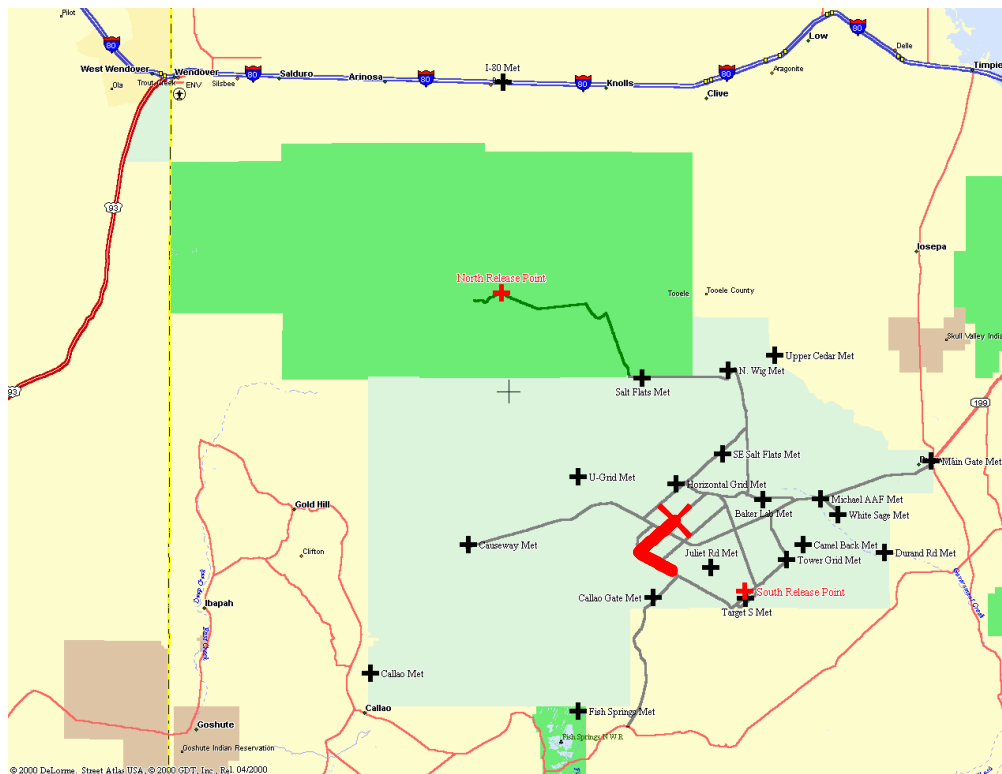
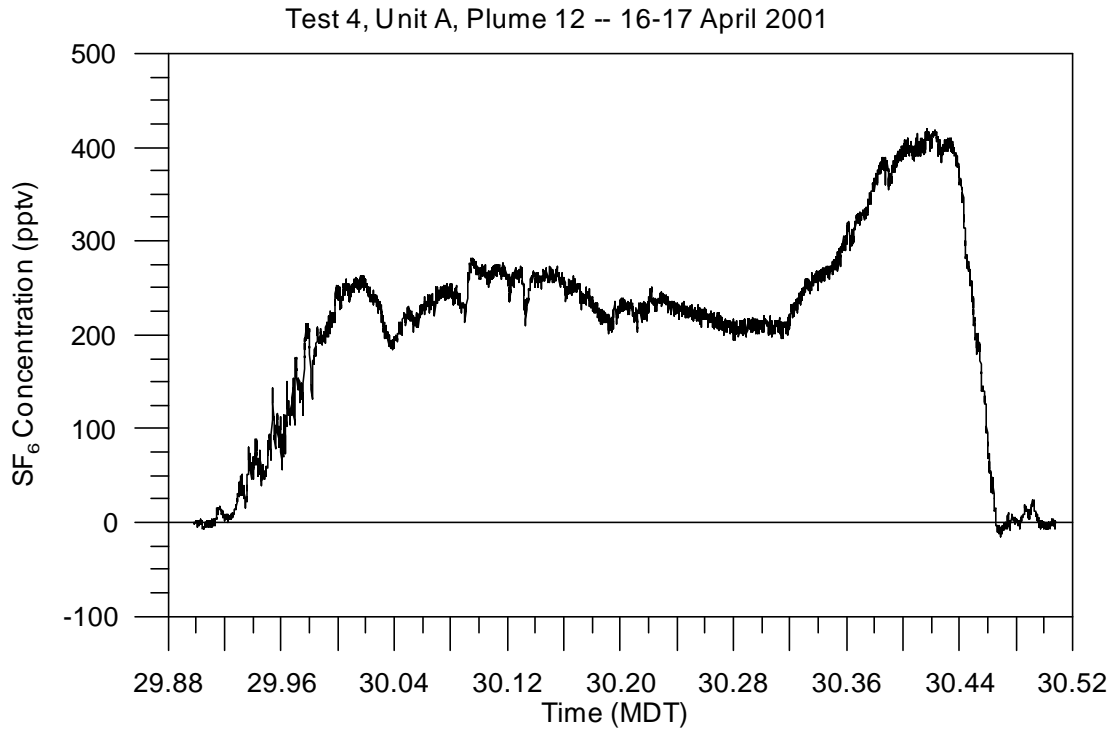


Figure A-133. SF₆ concentration of Plume 12 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

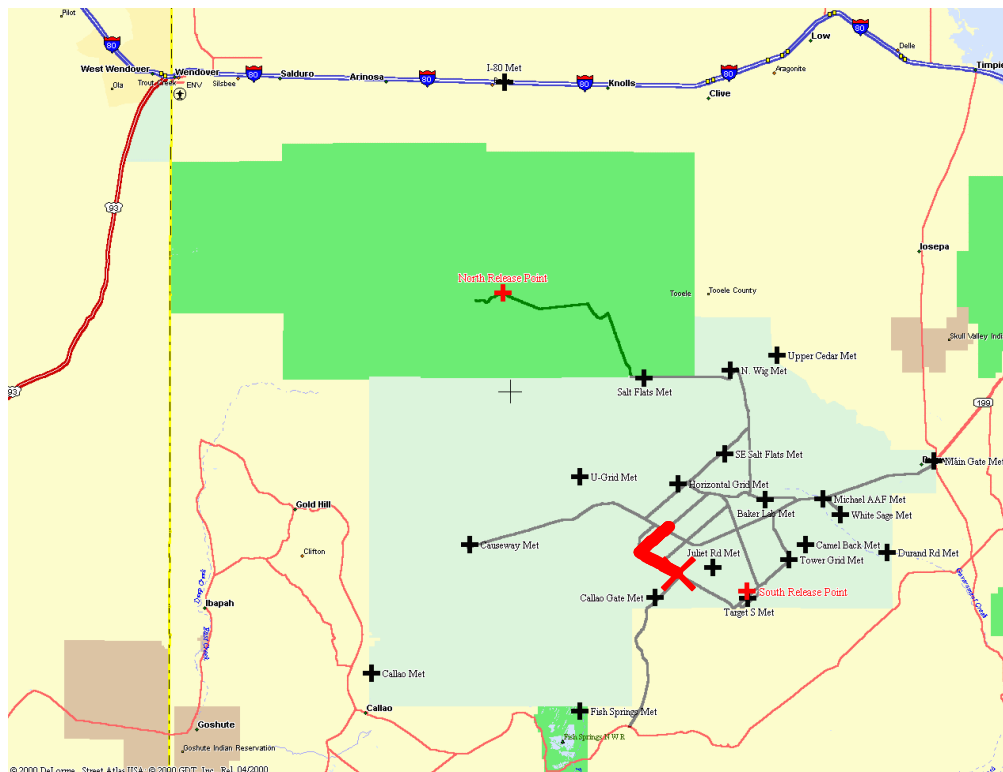
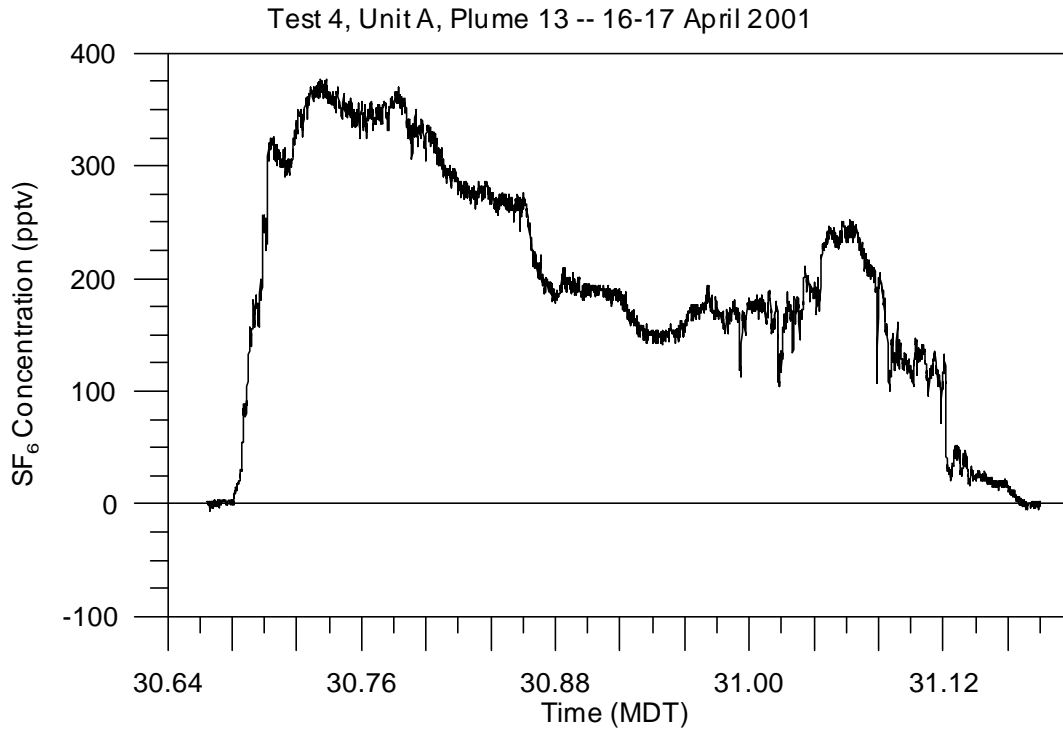


Figure A-134. SF₆ concentration of Plume 13 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

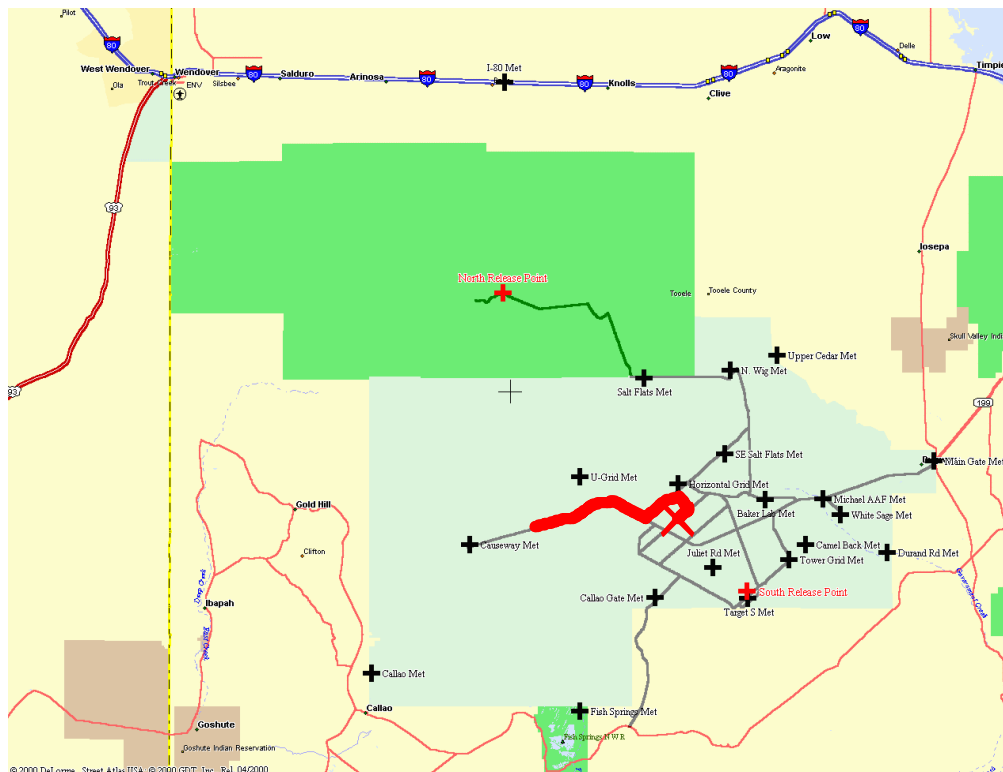
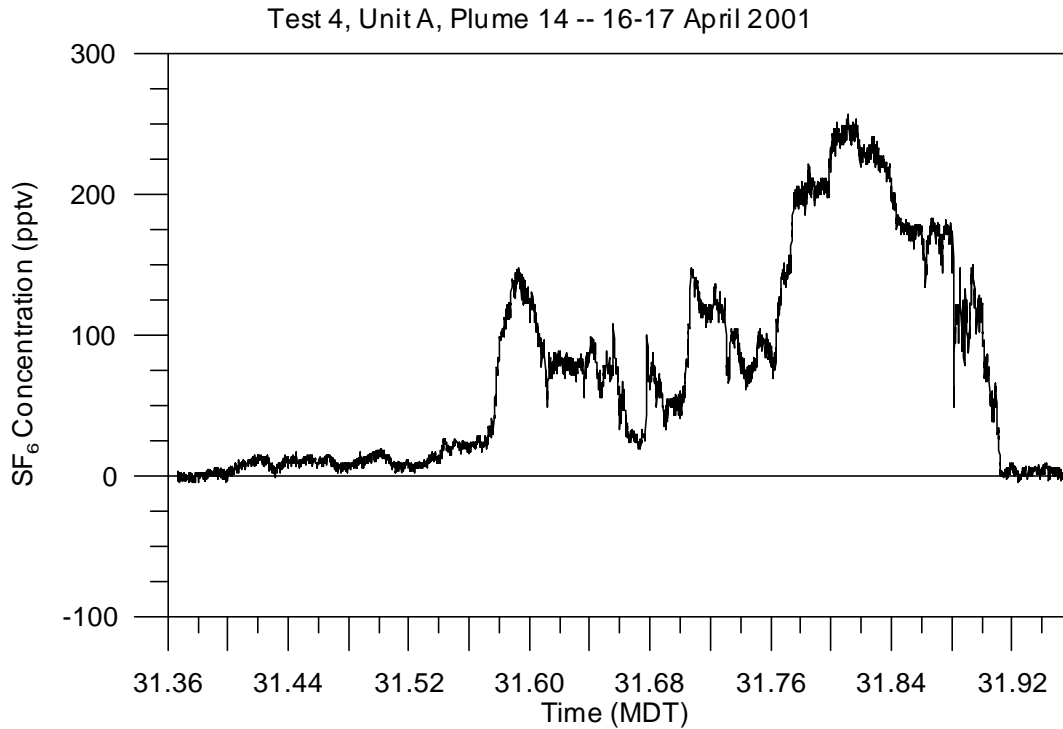


Figure A-135. SF₆ concentration of Plume 14 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

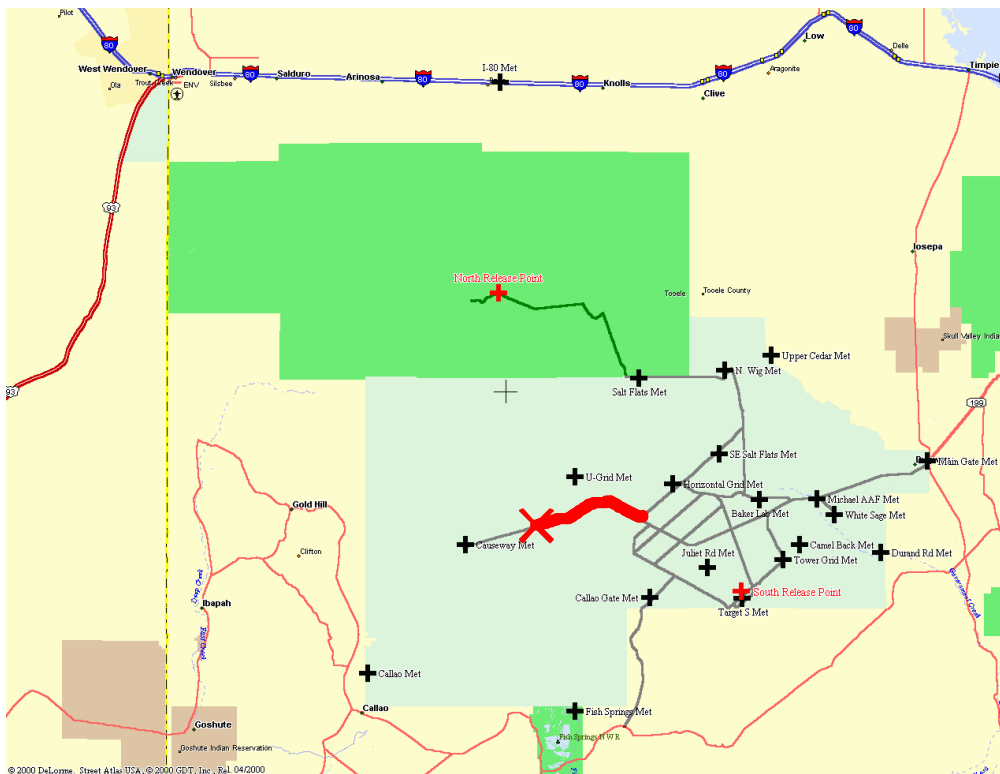
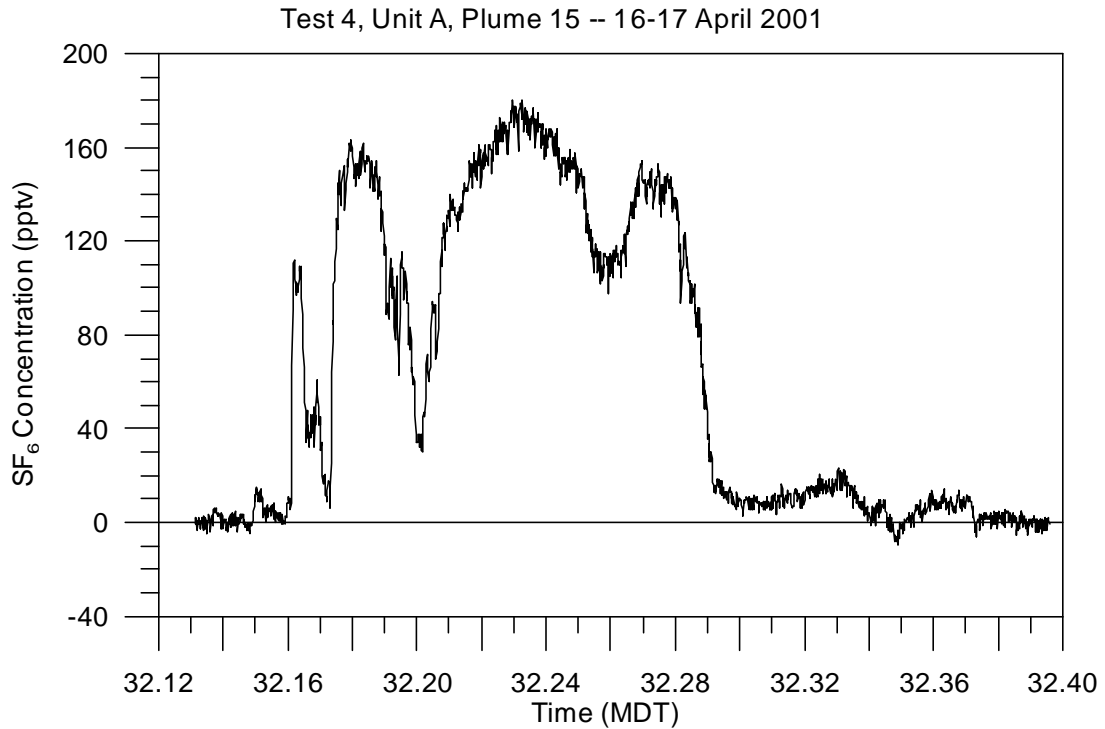


Figure A-136. SF₆ concentration of Plume 15 for Sampling Unit A during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

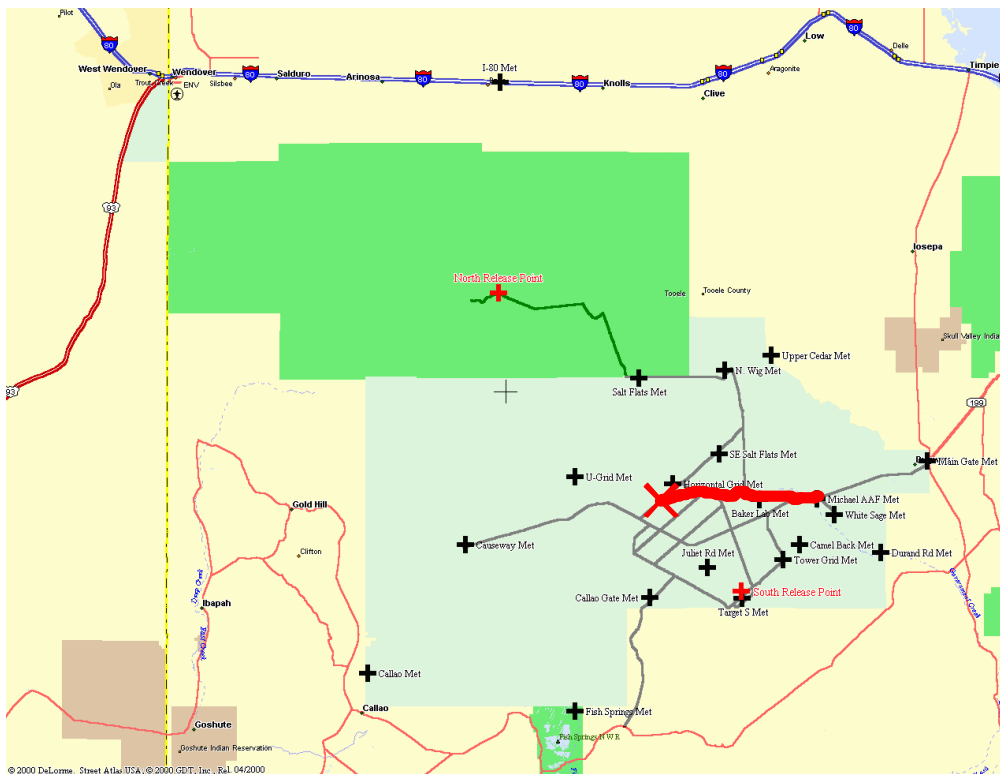
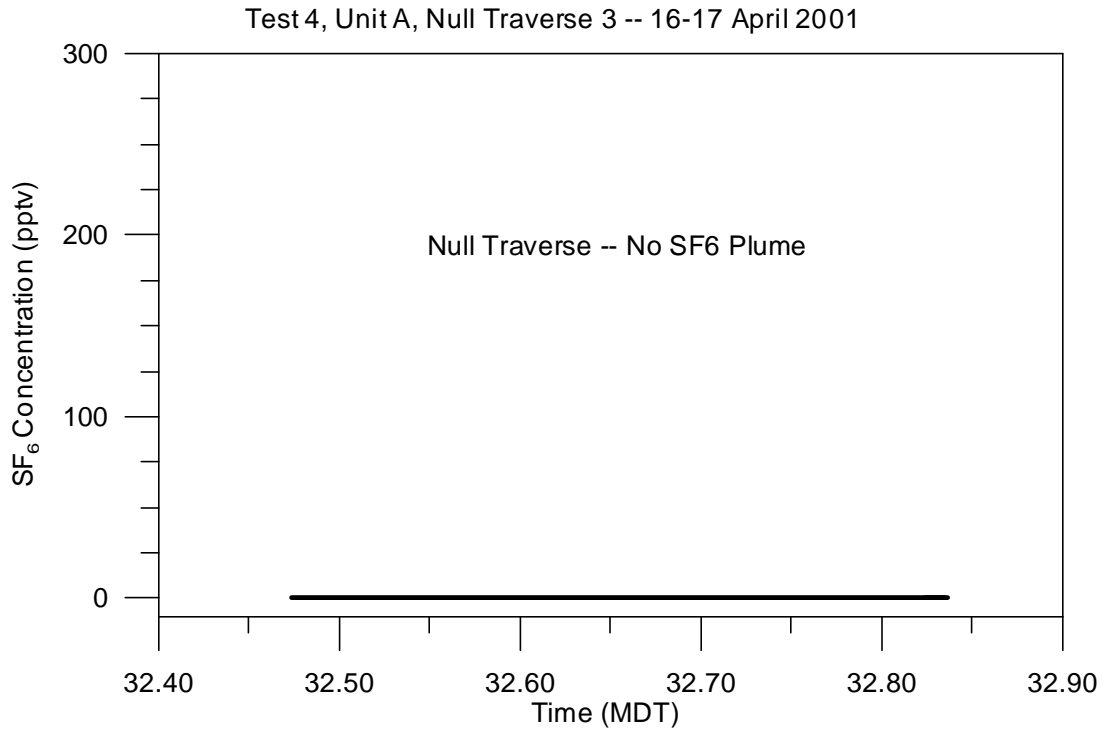


Figure A-137. Null sampling traverse 3 made by Sampling Unit A during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 4 Sampling Unit B

Table A-33. Test 4 Sampling Unit B sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	23:31	24:21
2	24:43	25:24

Table A-34. Summary of individual SF₆ plume characteristics measured by Sampling Unit B during Test 4. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time* (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	27:02-27:10	963	322.1-328.1	49.27	51.20	53.68
2	27:20-27:35	1844	321.0-329.3	48.77	51.61	55.55
3	27:40-27:54	1659	321.3-329.3	48.77	51.24	54.91
4	28:03-28:55	6200	320.9-342.2	32.96	43.90	55.64
5	29:44-30:03	2347	321.9-333.3	41.34	47.61	53.94
6	32:17-32:44	3135	326.3-344.9	32.50	40.47	50.10

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

Table A-35. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit B during Test 4.

Plume Number	Concentration (pptv)	Time* (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	117.2	27:09	40.436137	113.424745	322.7	52.65
2	341.8	27:27	40.431847	113.402753	324.1	51.15
3	366.0	27:47	40.431997	113.400690	324.3	51.06
4	365.7	28:12	40.431623	113.405180	323.9	51.25
5	91.8	29:54	40.437832	113.327037	330.8	48.23
6	65.3	32:23	40.423703	113.312870	331.1	46.27

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

Table A-36. Test 4 Sampling Unit B sampling traverses yielding no detectable SF₆ (null pass) during active SF₆ plume encounters.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
3	30:35	31:24
4	31:28	32:09

Table A-37. Test 4 Sampling Unit B sampling traverses yielding no detectable SF₆ (null pass) after active SF₆ plume encounters.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
5	32:55	33:29

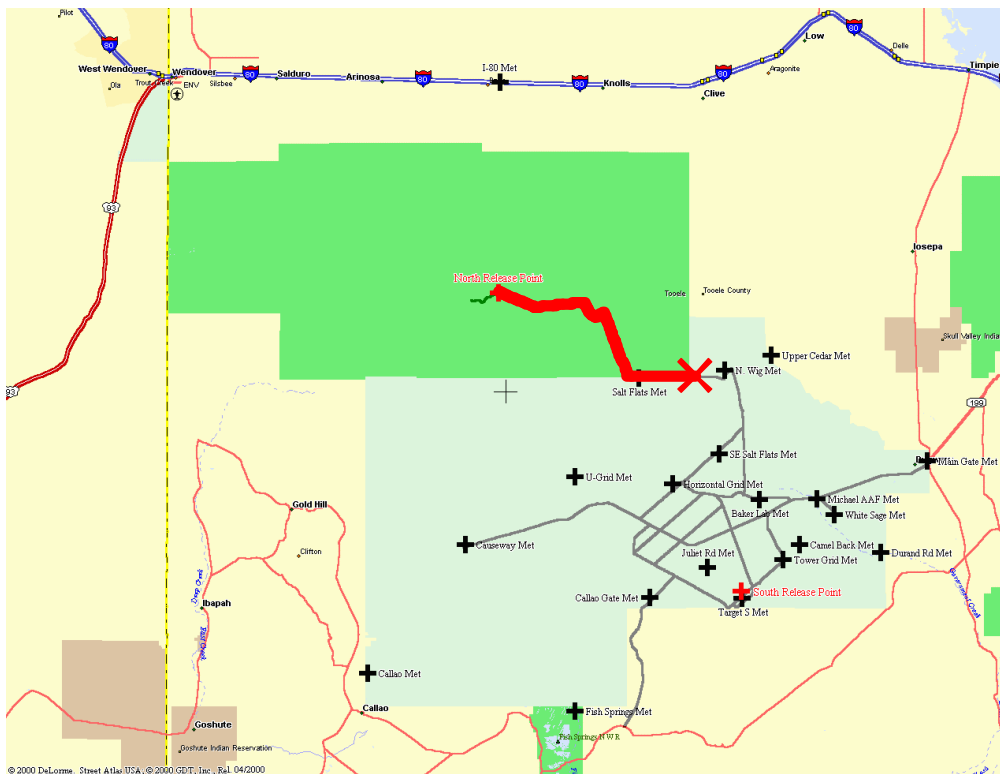
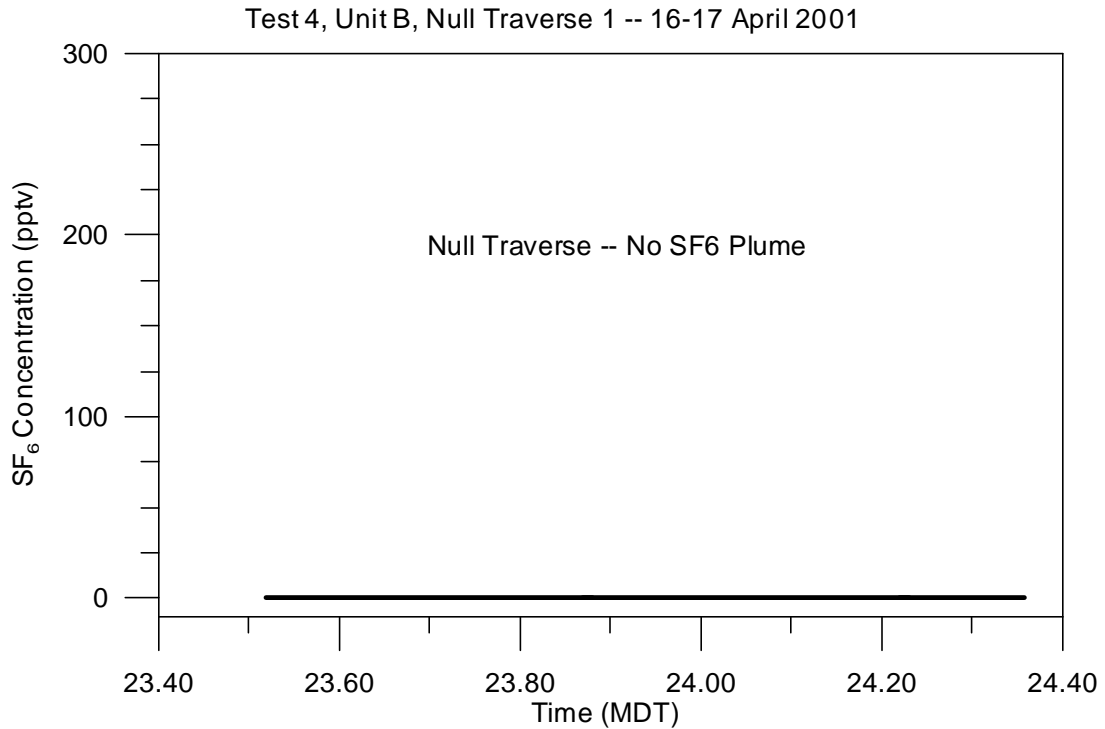


Figure A-138. Null sampling traverse 1 made by Sampling Unit B during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

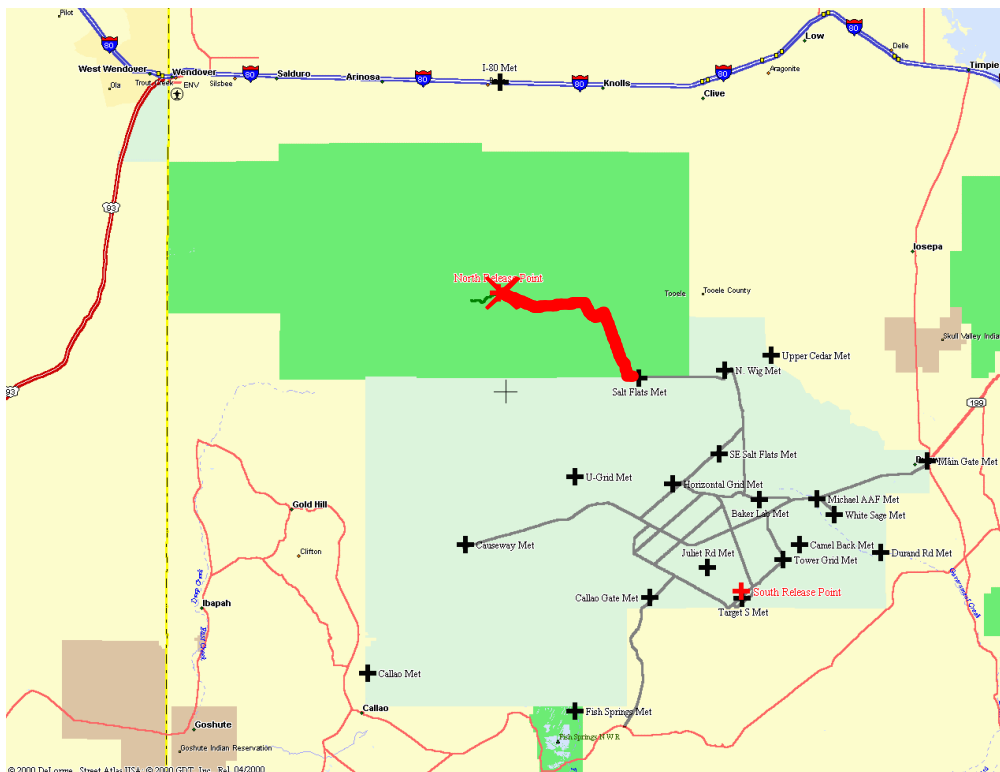
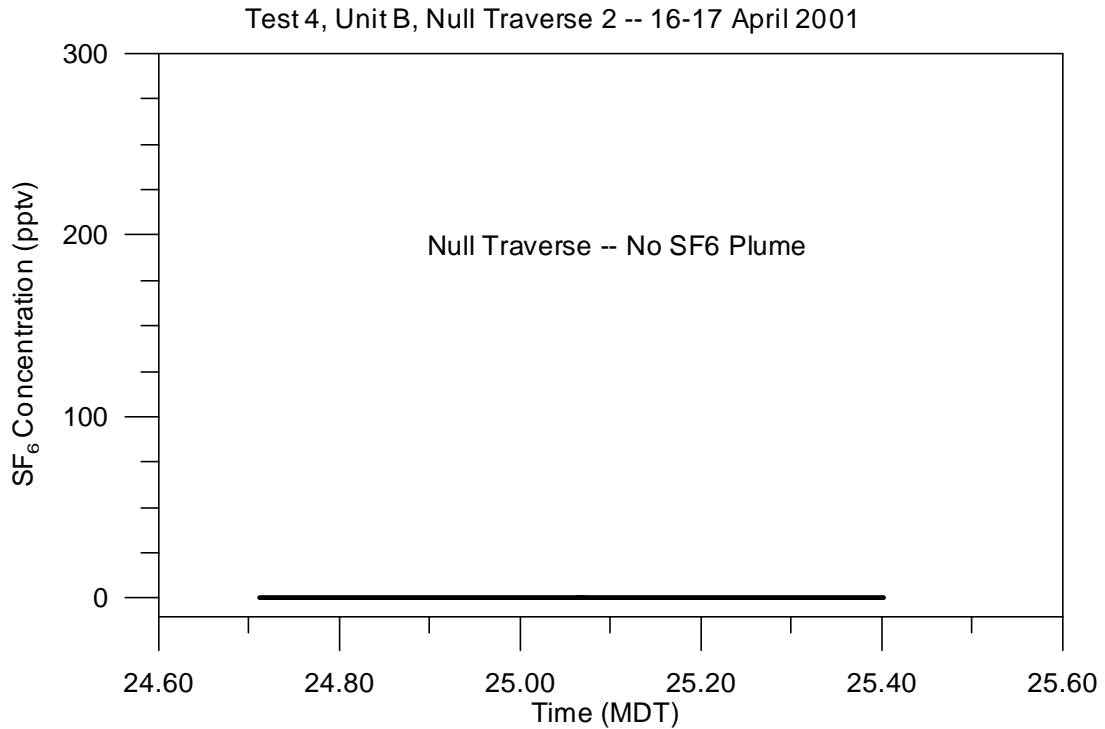


Figure A-139. Null sampling traverse 2 made by Sampling Unit B during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

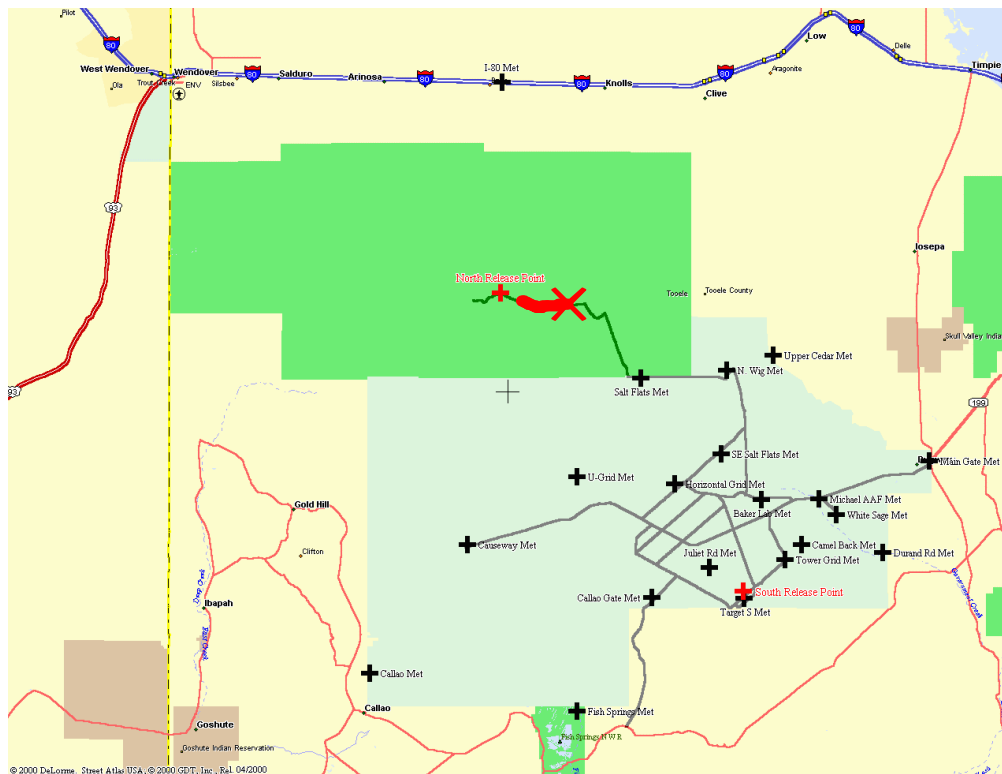
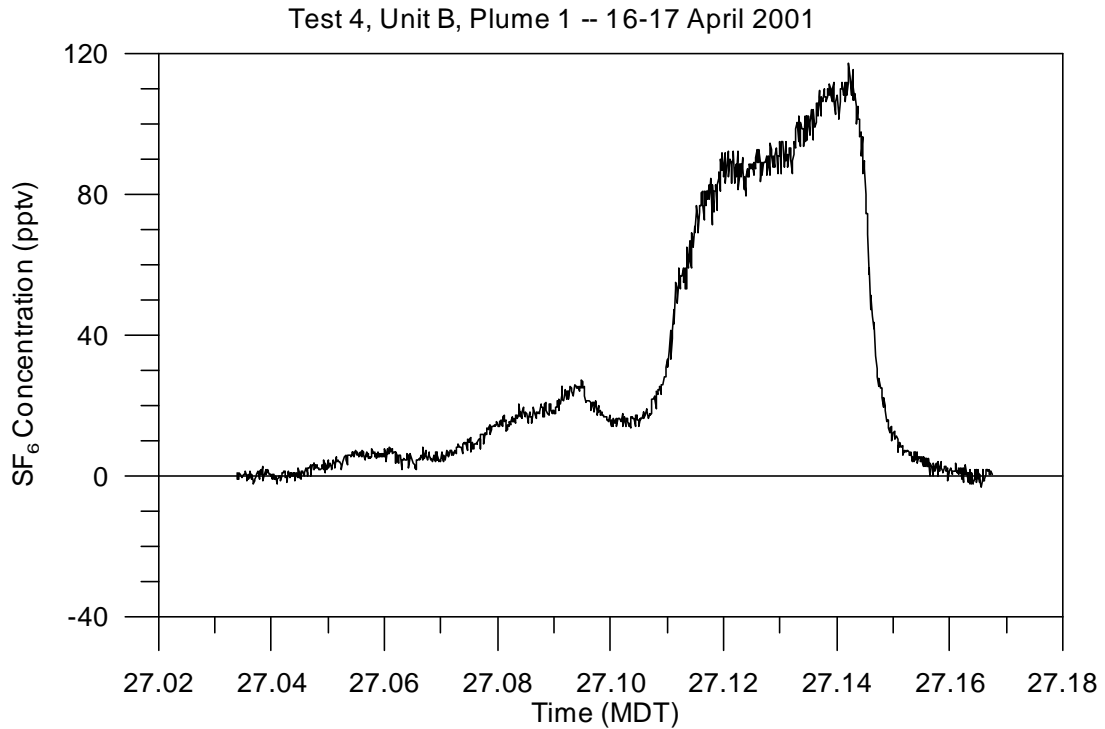


Figure A-140. SF₆ concentration of Plume 1 for Sampling Unit B during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

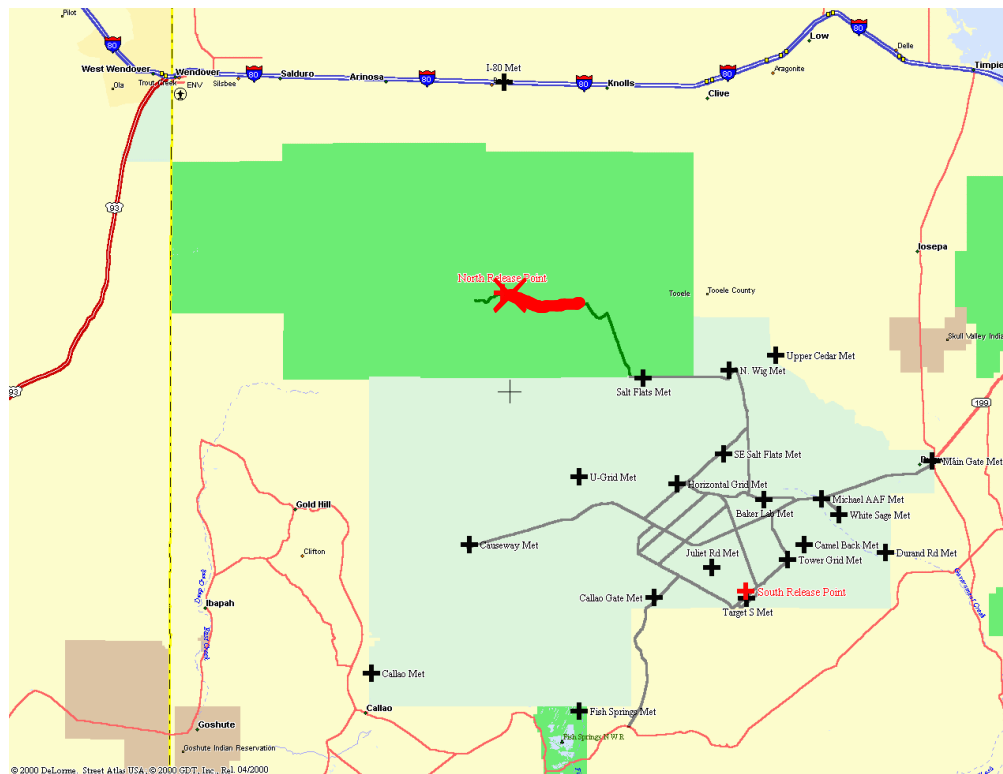
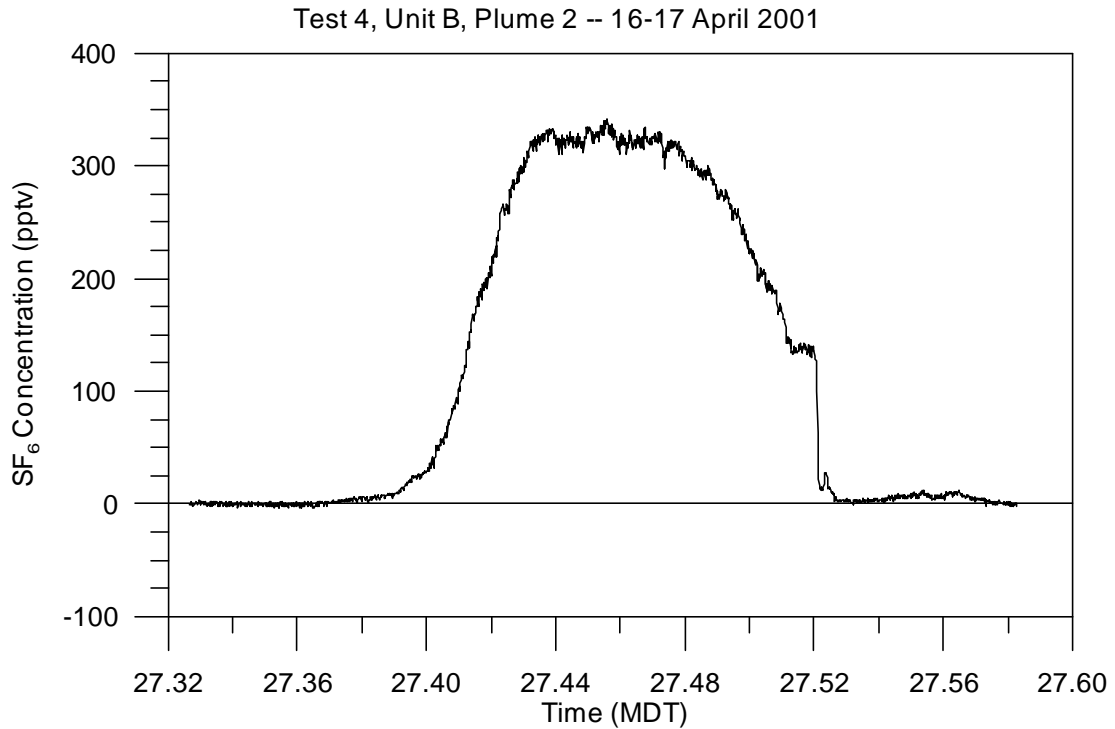


Figure A-141. SF₆ concentration of Plume 2 for Sampling Unit B during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

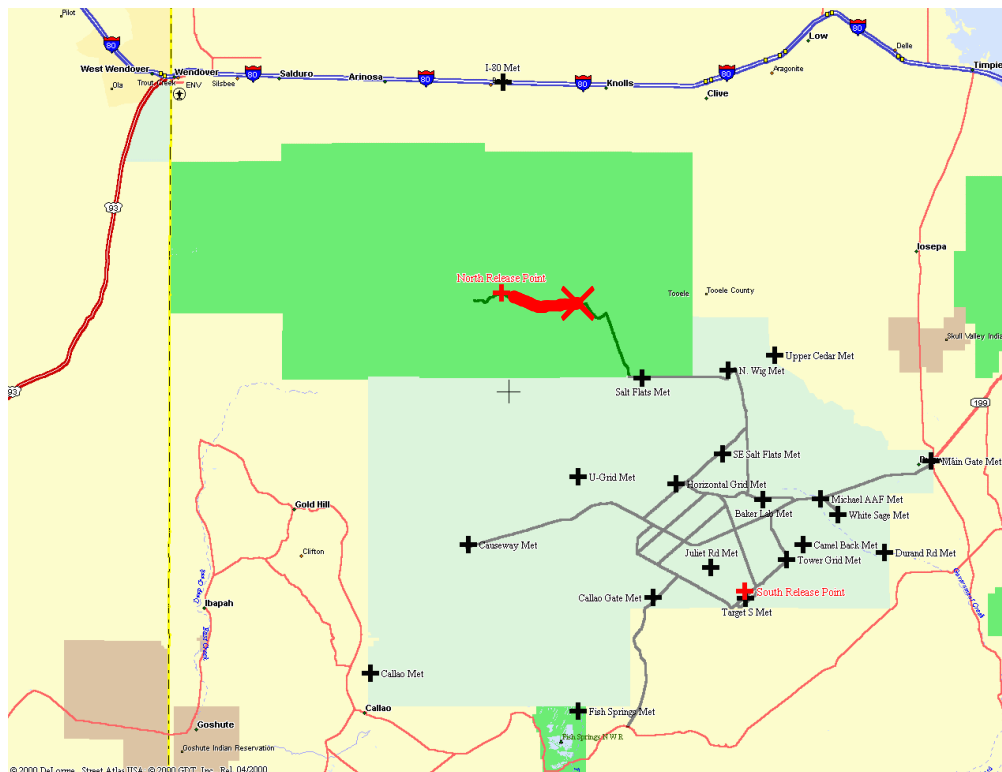
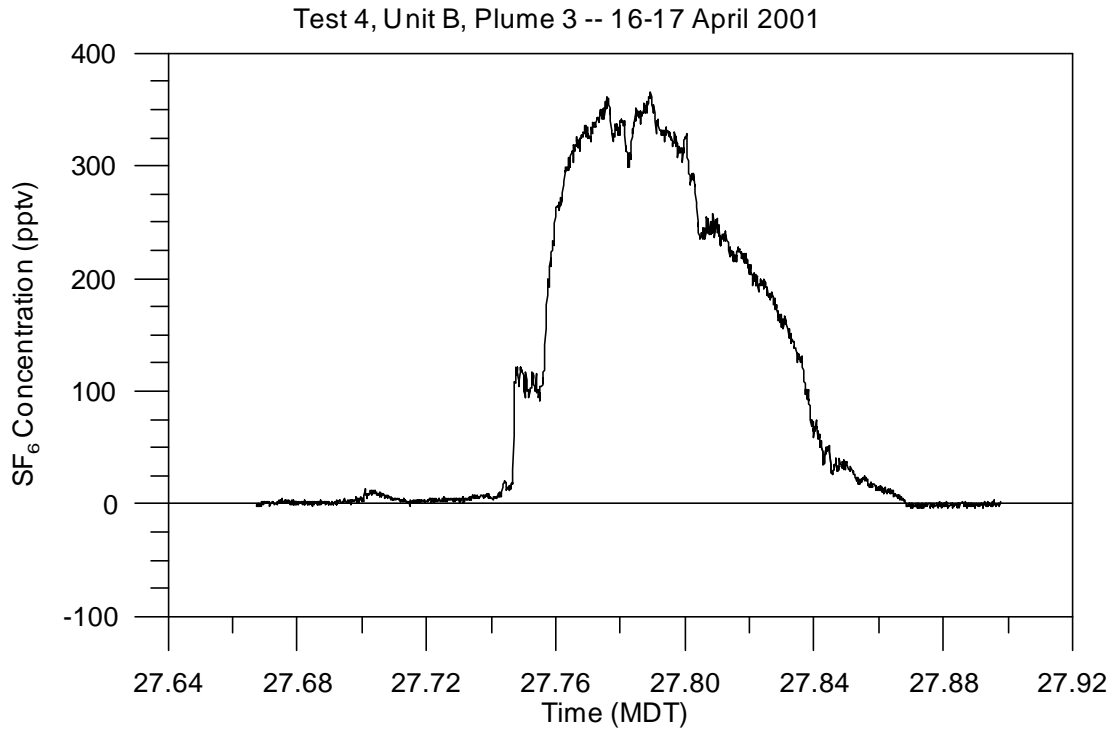


Figure A-142. SF₆ concentration of Plume 3 for Sampling Unit B during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

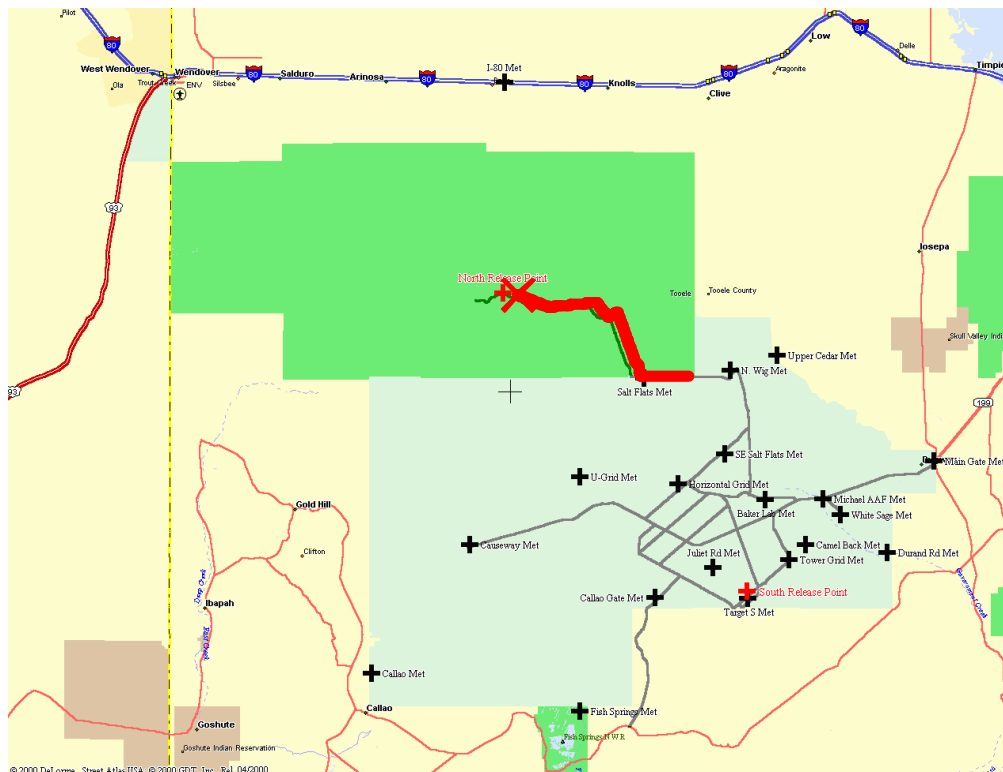
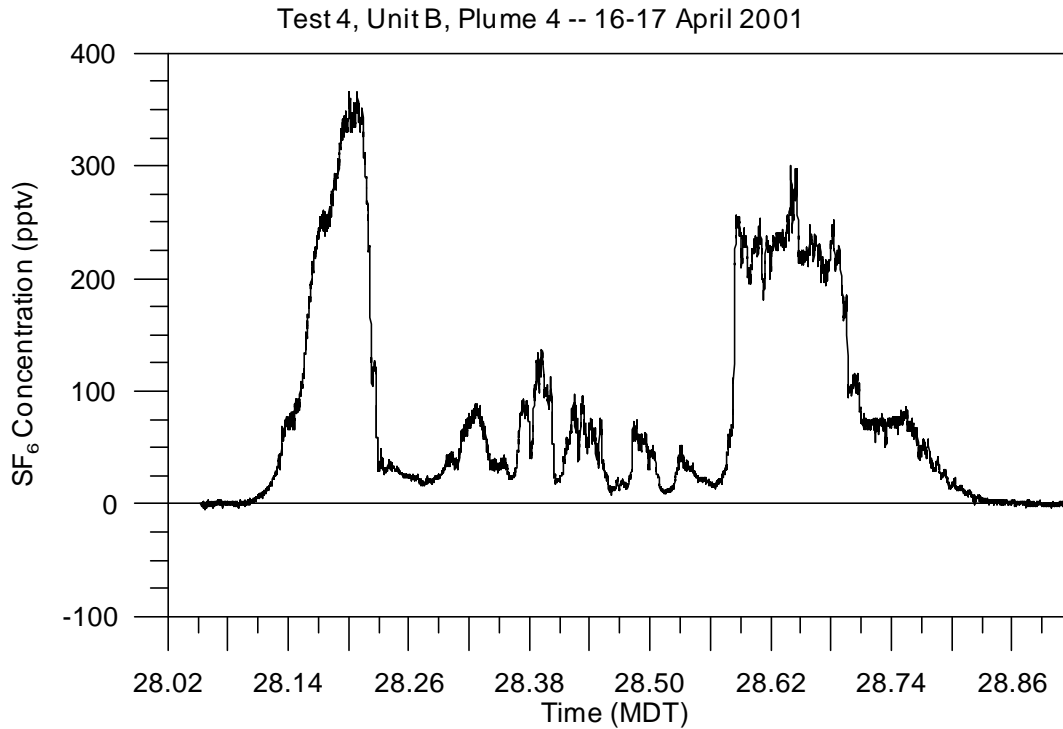


Figure A-143. SF₆ concentration of Plume 4 for Sampling Unit B during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

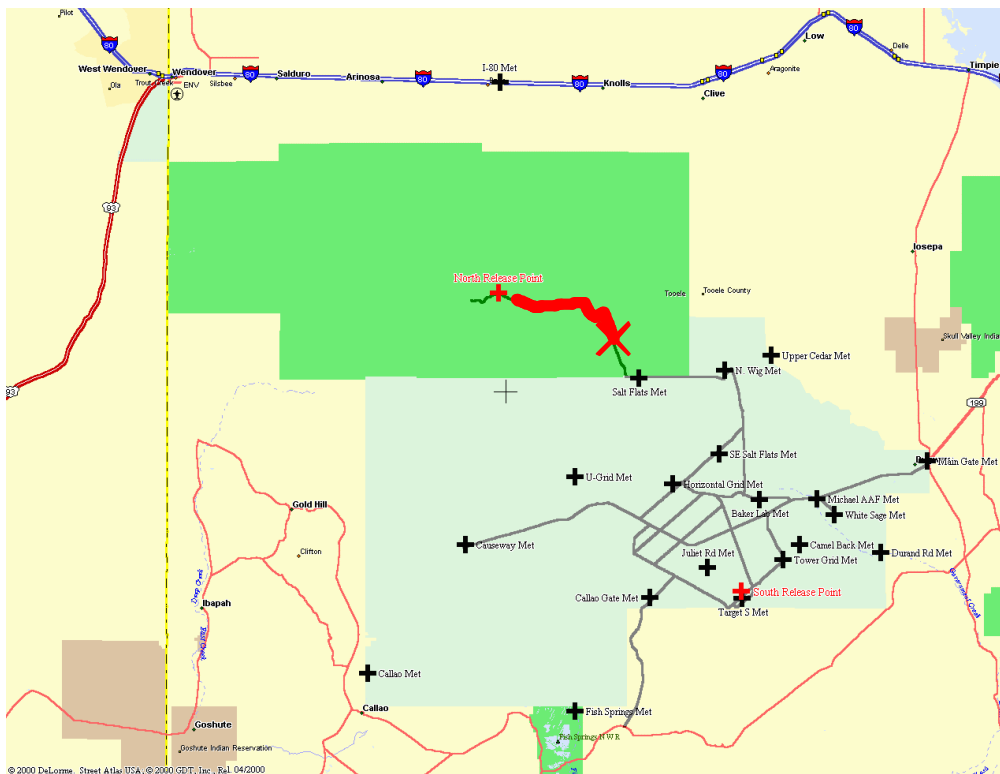
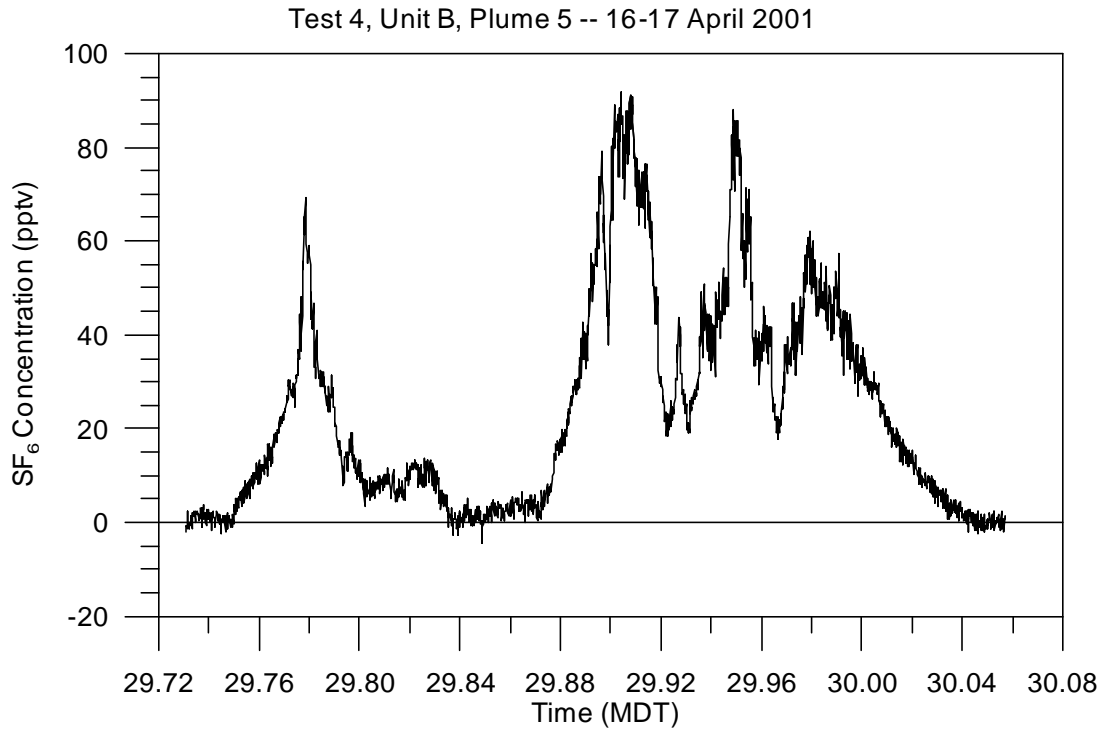


Figure A-144. SF₆ concentration of Plume 5 for Sampling Unit B during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

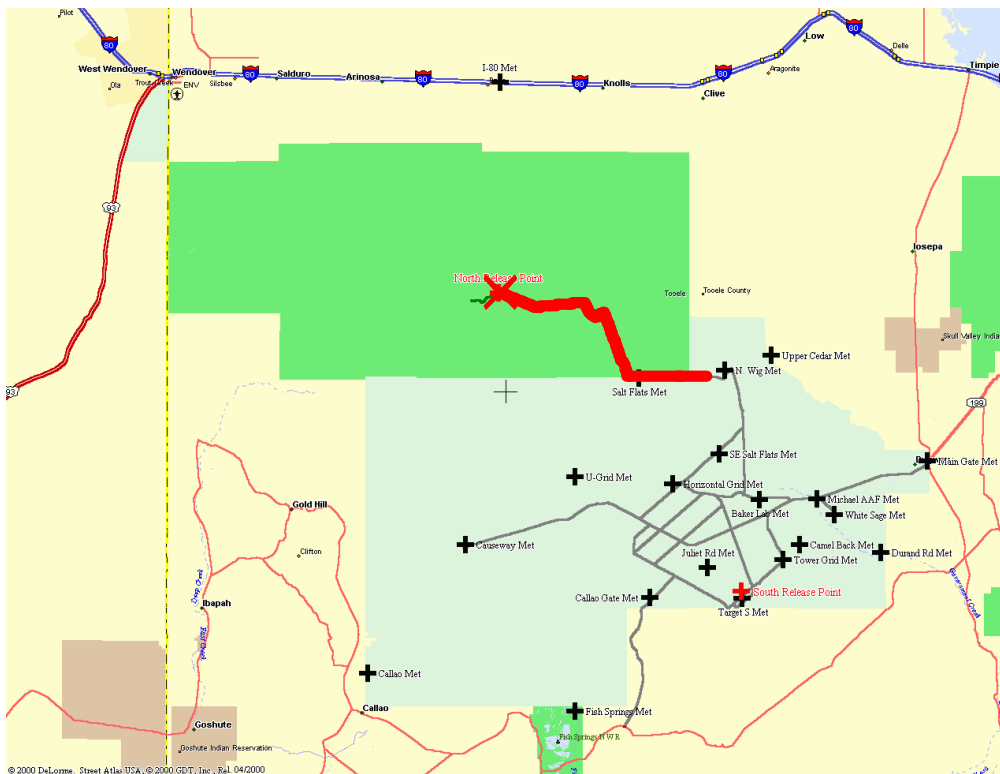
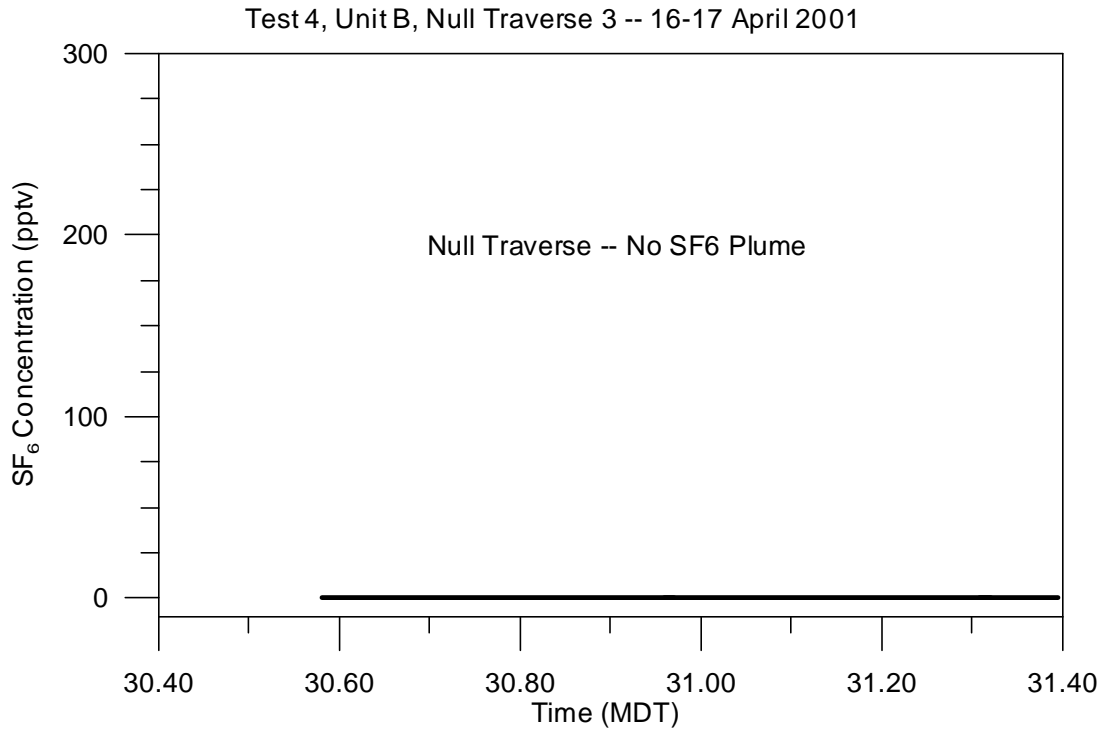


Figure A-145. Null sampling traverse 3 made by Sampling Unit B during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

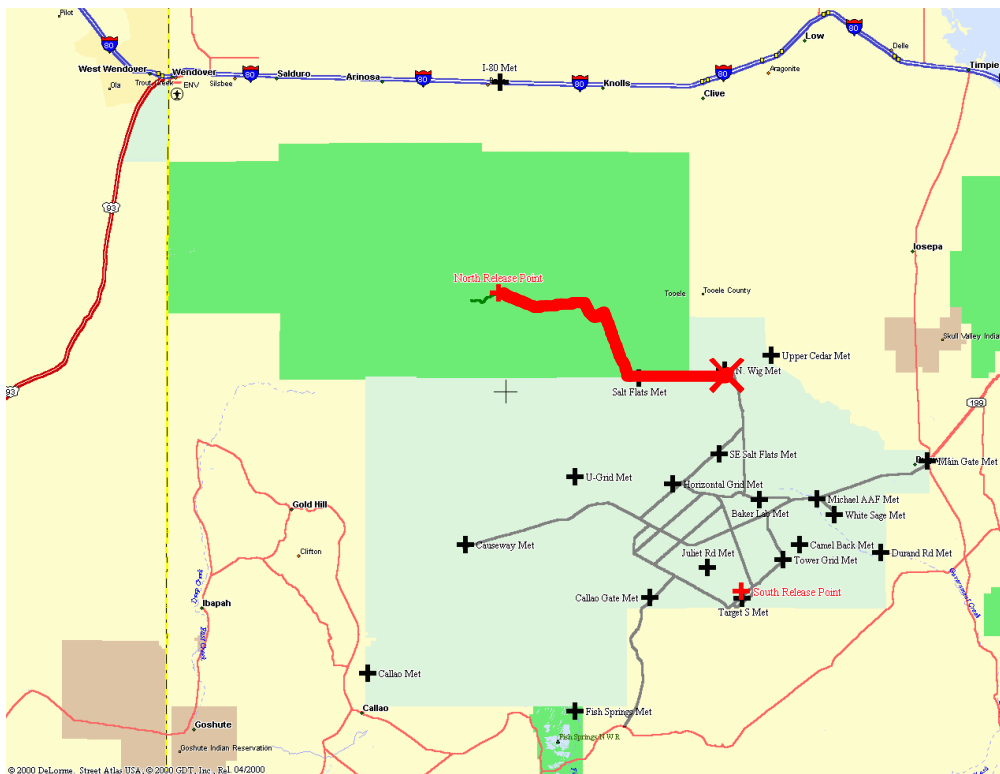
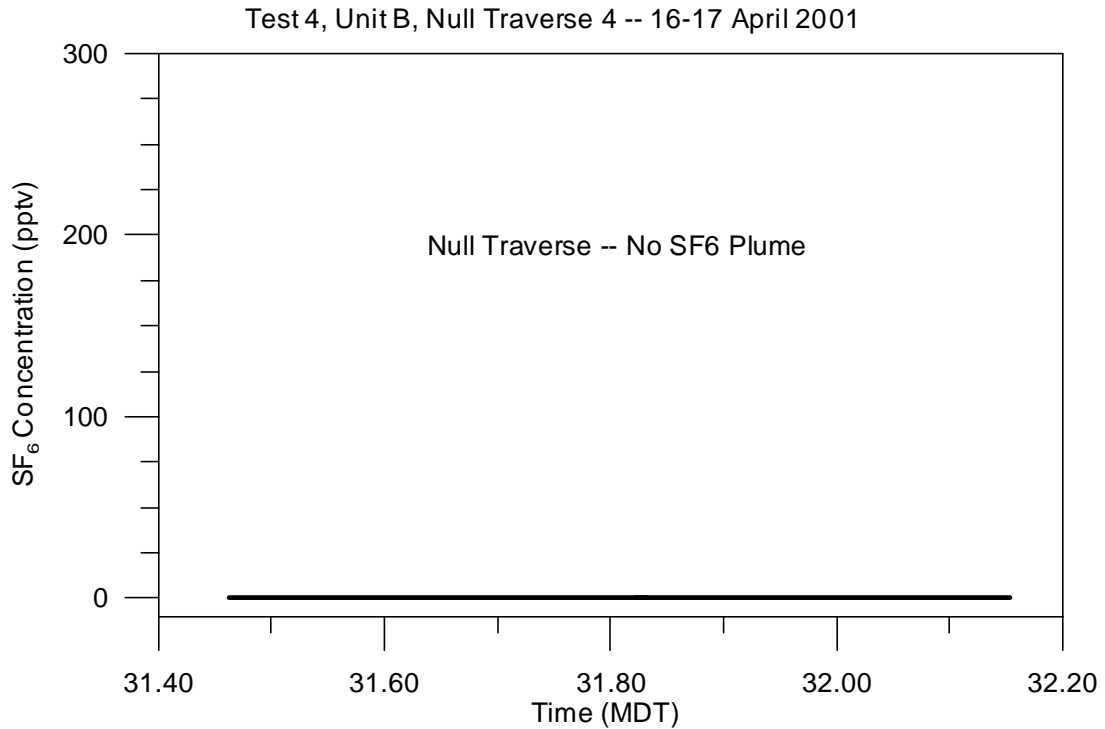


Figure A-146. Null sampling traverse 4 made by Sampling Unit B during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

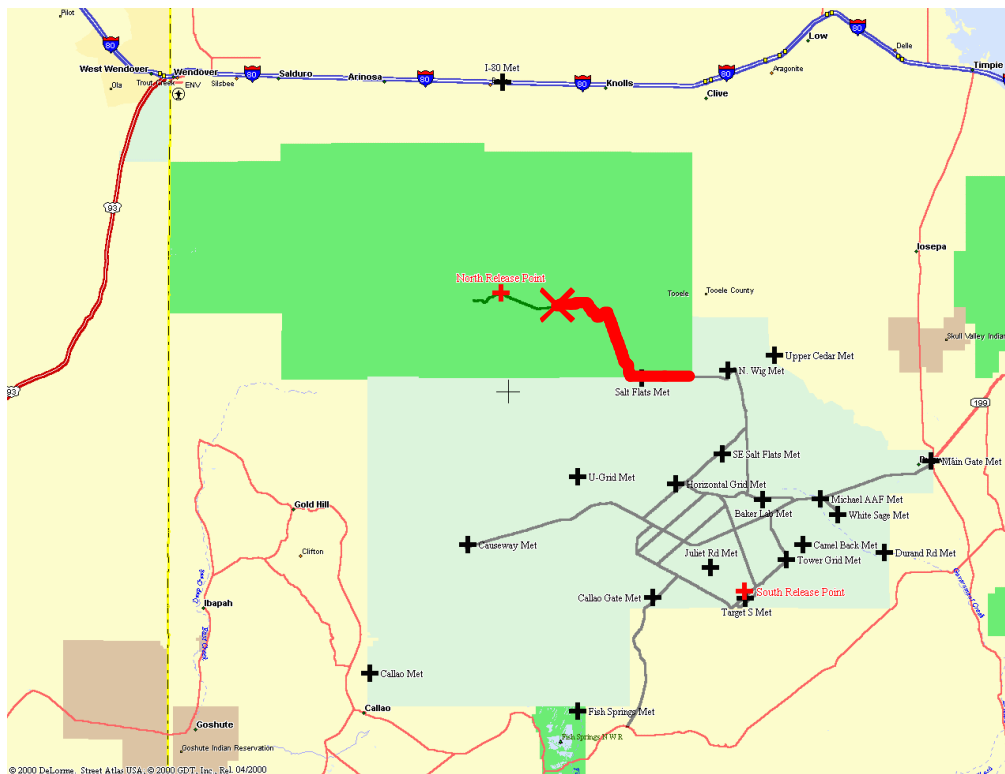
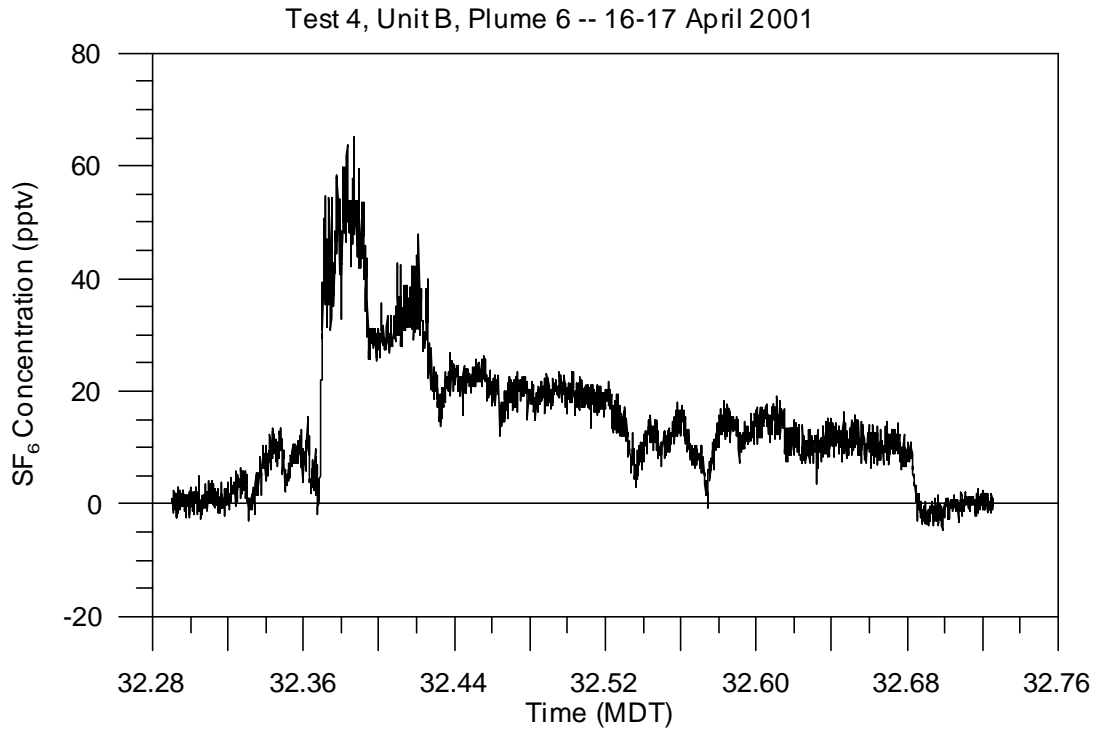


Figure A-147. SF₆ concentration of Plume 6 for Sampling Unit B during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

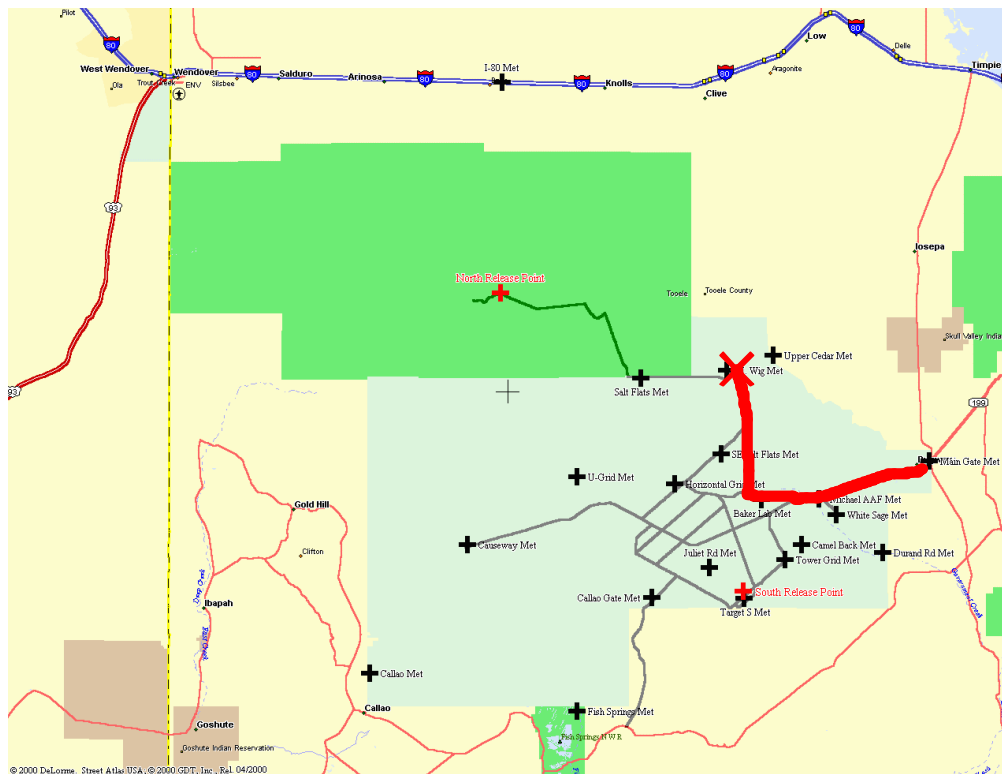
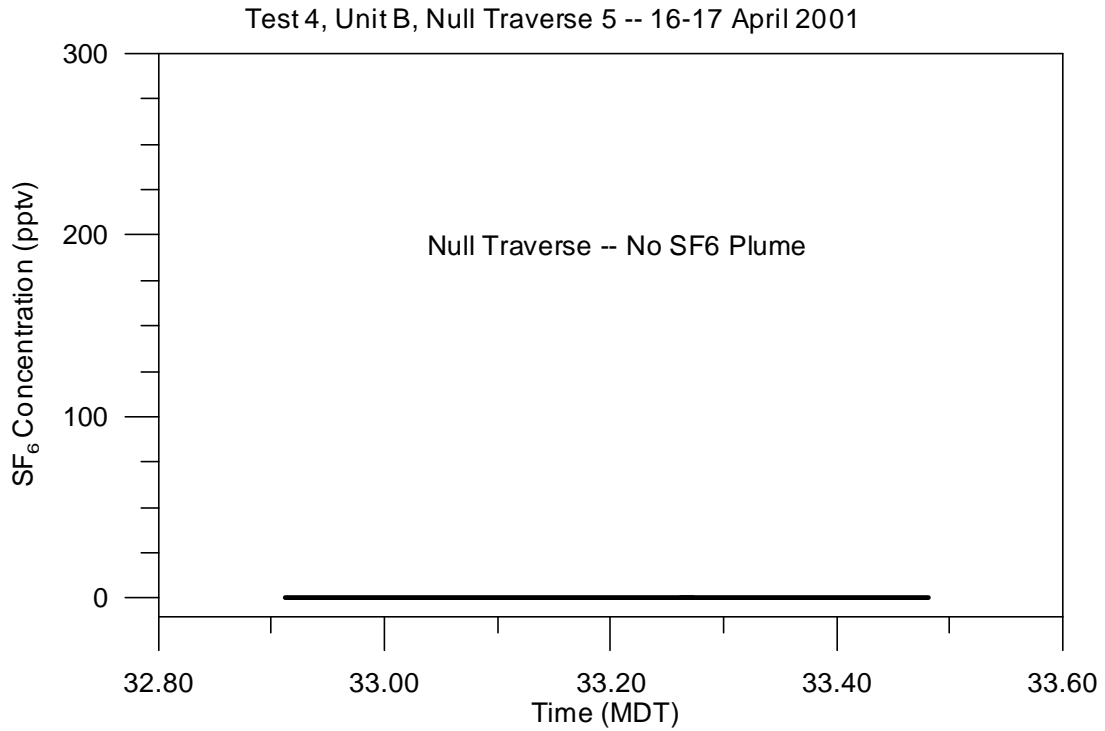


Figure A-148. Null sampling traverse 5 made by Sampling Unit B during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 4 Sampling Unit C

Table A-38. Test 4 Sampling Unit C sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	23:55	24:12
2	25:09	25:48
3	26:09	26:51
4	27:08	27:54

Table A-39. Summary of individual SF₆ plume characteristics measured by Sampling Unit C during Test 4. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time* (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	28:11-28:15	461	342.1-345.3	76.49	76.81	77.57
2	28:15-28:19	487	342.8-345.2	76.49	76.73	77.19
3	28:20-28:25	621	343.0-346.1	76.32	76.63	77.10
4	28:41-28:45	561	343.1-345.9	76.38	76.63	77.05
5	28:56-29:05	1108	340.7-345.4	76.49	77.11	78.25
6	29:06-31:04	14140**	334.3-352.0	74.87	77.56	82.31
7	32:38-32:40	281	349.3-352.1	74.83	75.14	75.49
8	32:44-32:47	381	342.0-345.6	76.66	77.40	78.17
9	32:47-32:54	901	334.0-341.8	78.29	80.55	83.08
10	32:54-32:56	281	332.2-334.5	82.71	83.59	84.48

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

**Large number of data points mandated using every other data point in this analysis.

Table A-40. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit C during Test 4.

Plume Number	Concentration (pptv)	Time* (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	27.4	28:13	40.722595	113.295535	344.2	76.59
2	26.4	28:16	40.722730	113.292807	344.4	76.54
3	15.0	28:23	40.722793	113.291975	344.4	76.53
4	21.9	28:43	40.723390	113.287607	344.7	76.50
5	26.8	29:01	40.722895	113.308190	343.4	76.92
6	96.1**	30:34	40.724802	113.281430	345.1	76.51
7	22.0	32:39	40.726535	113.187363	351.1	75.04
8	12.2	32:45	40.728188	113.305100	343.7	77.41
9	62.2	32:50	40.729410	113.398198	338.3	80.13
10	16.8	32:56	40.731822	113.500663	332.8	83.99

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

**Large number of data points mandated using every other data point in this analysis. In addition, a signal spike caused by accidentally turning off the analyzer sampling pump resulted in the determination of a false maximum value. The value reported here is with the data spike removed.

No null passes were made by Sampling Unit C either during or after the time period of active plume sampling listed in the previous two tables.

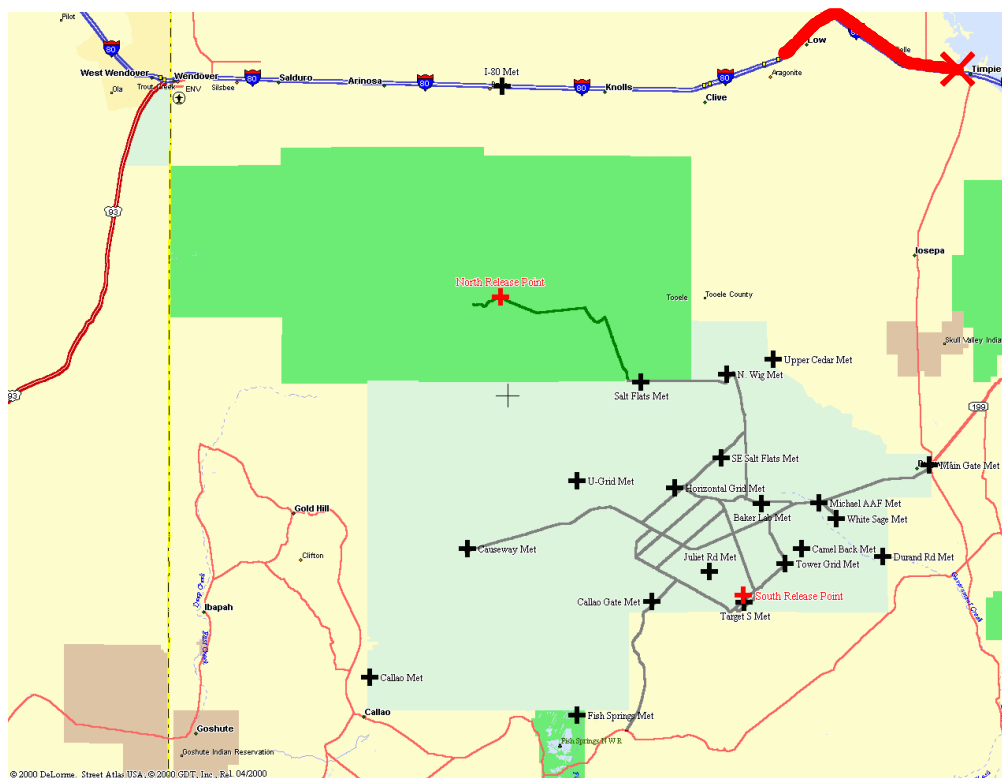
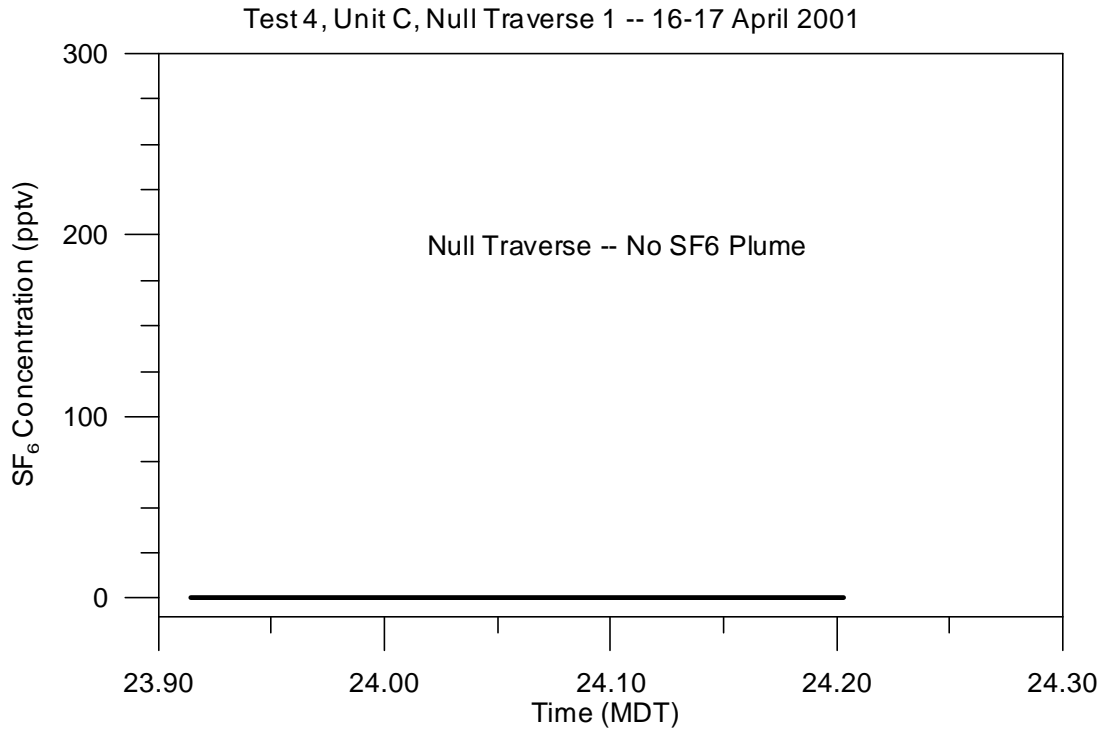


Figure A-149. Null sampling traverse 1 made by Sampling Unit C during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

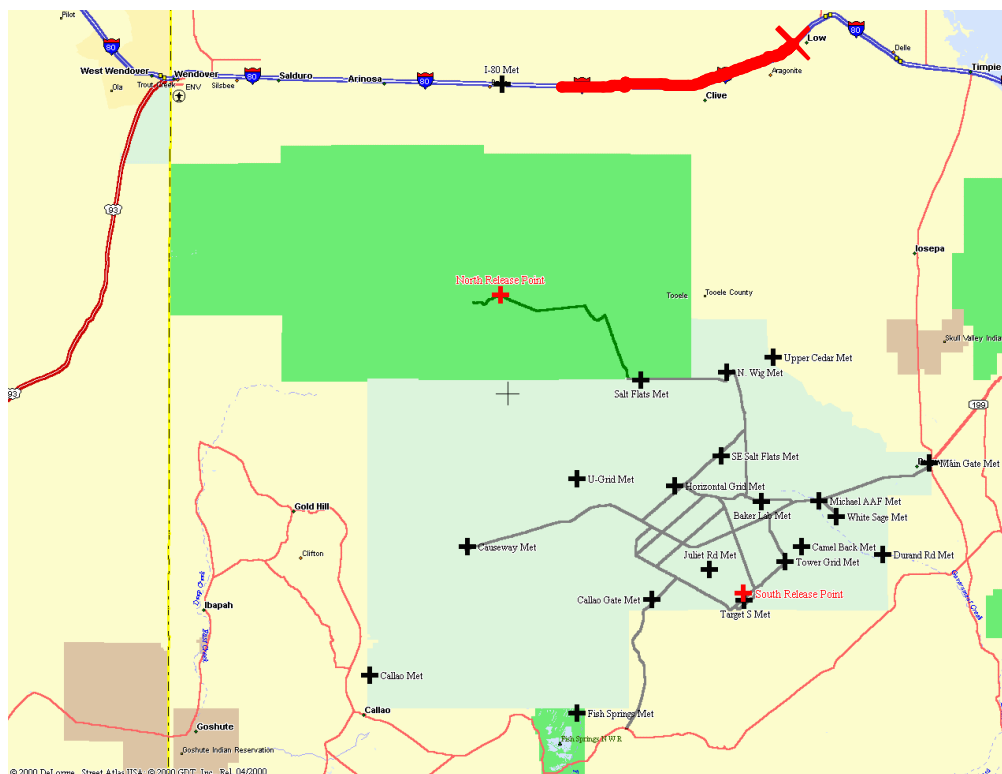
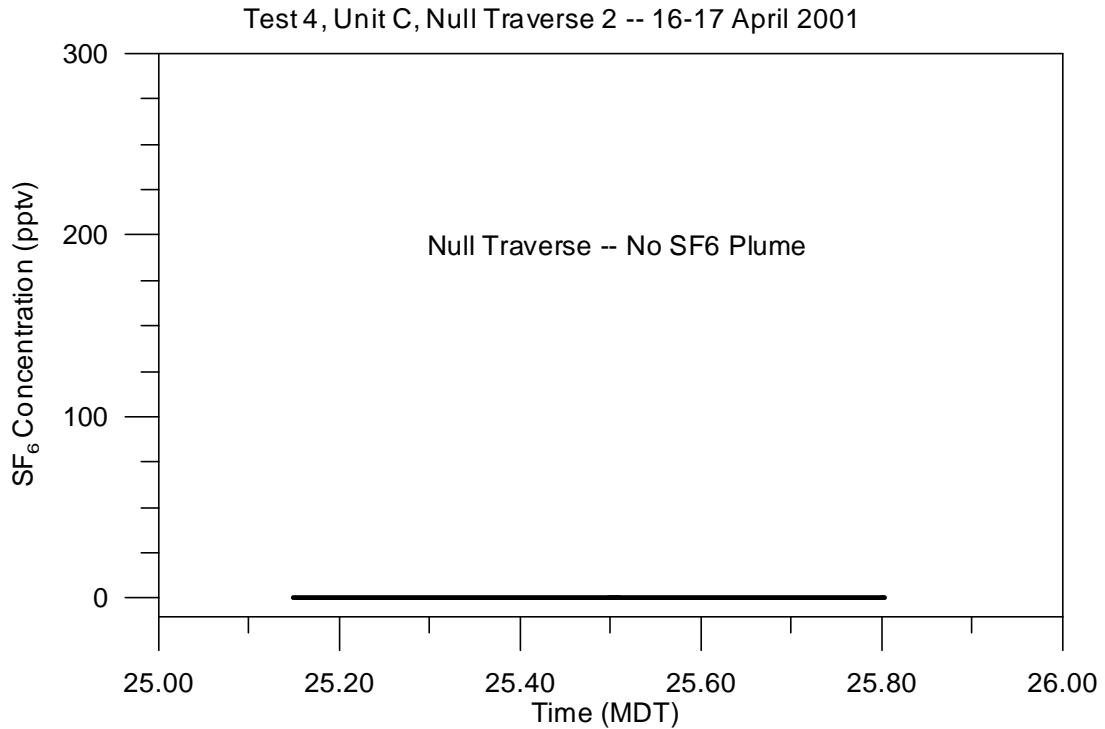


Figure A-150. Null sampling traverse 2 made by Sampling Unit C during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 4, Unit C, Null Traverse 3 -- 16-17 April 2001

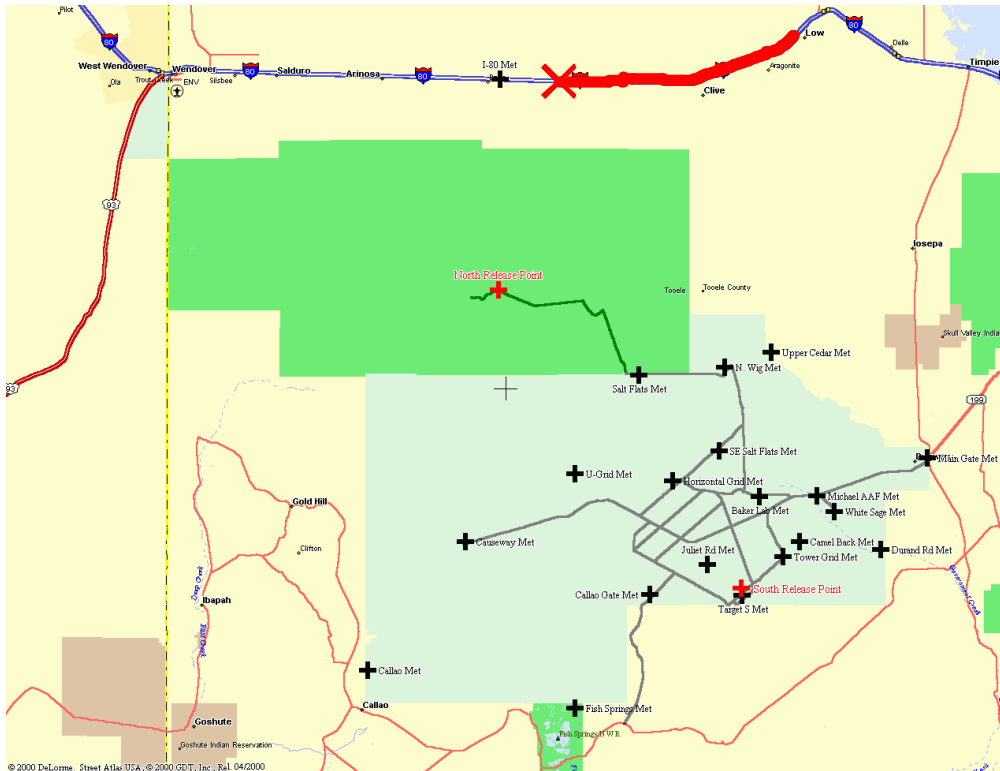
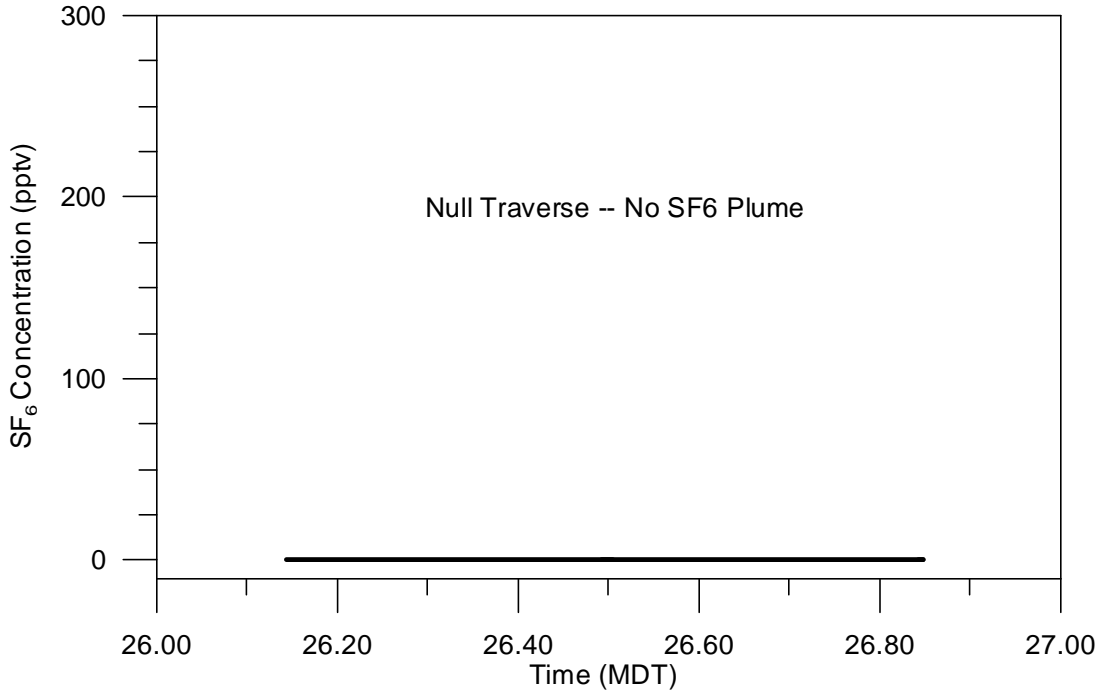


Figure A-151. Null sampling traverse 3 made by Sampling Unit C during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 4, Unit C, Null Traverse 4 -- 16-17 April 2001

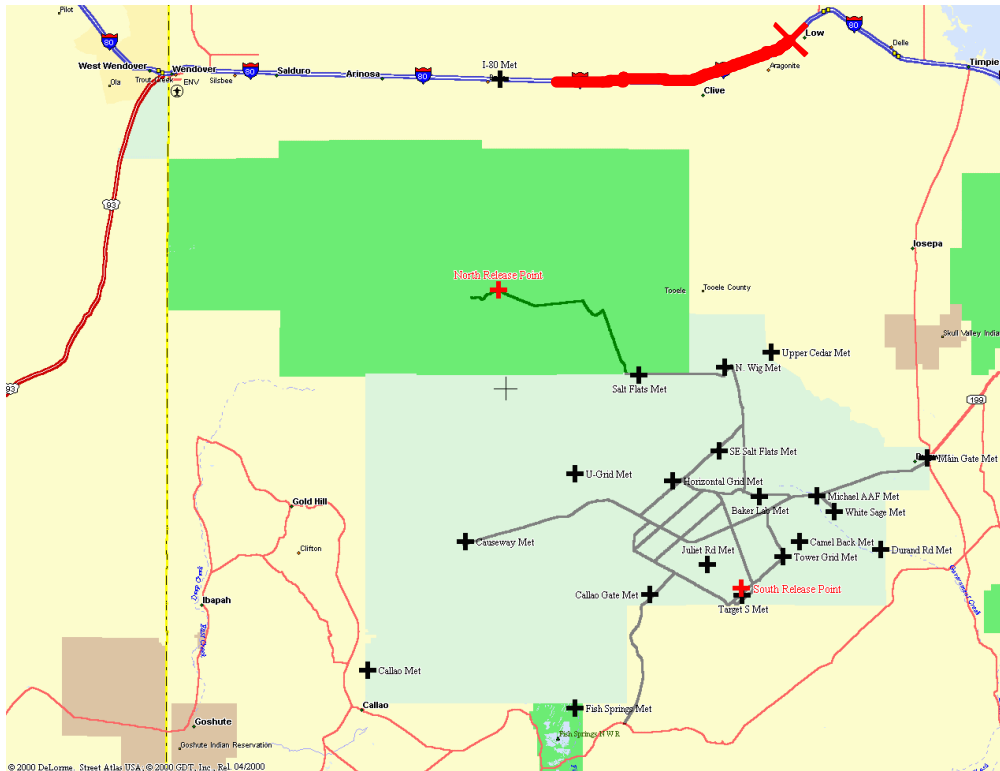
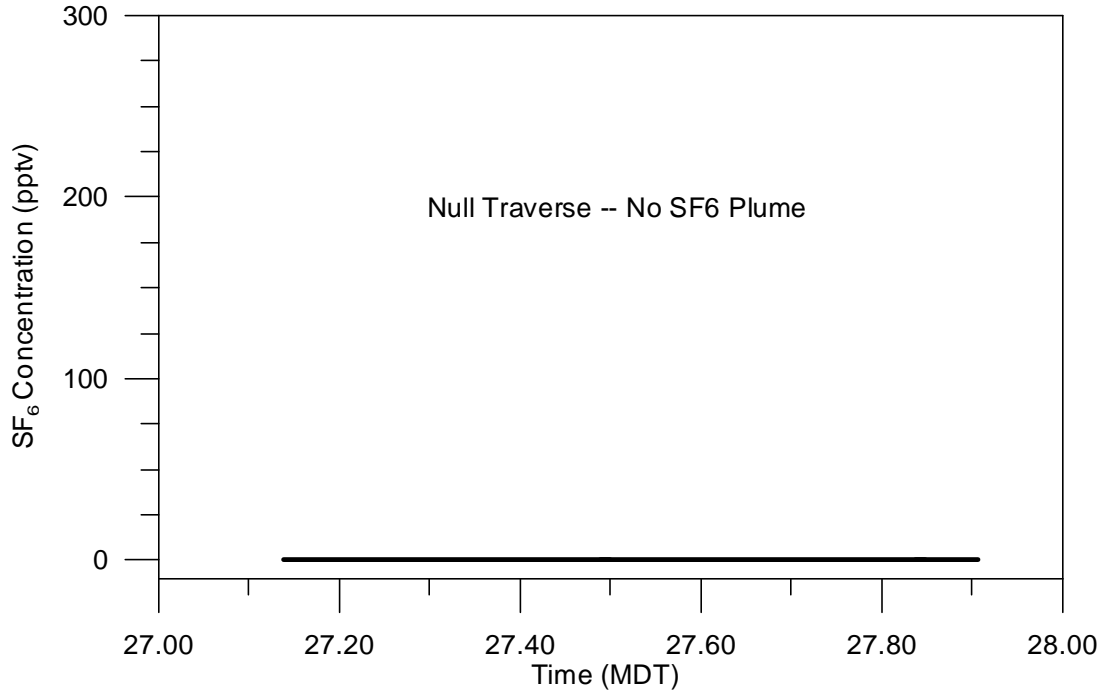


Figure A-152. Null sampling traverse 4 made by Sampling Unit C during Test 4, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

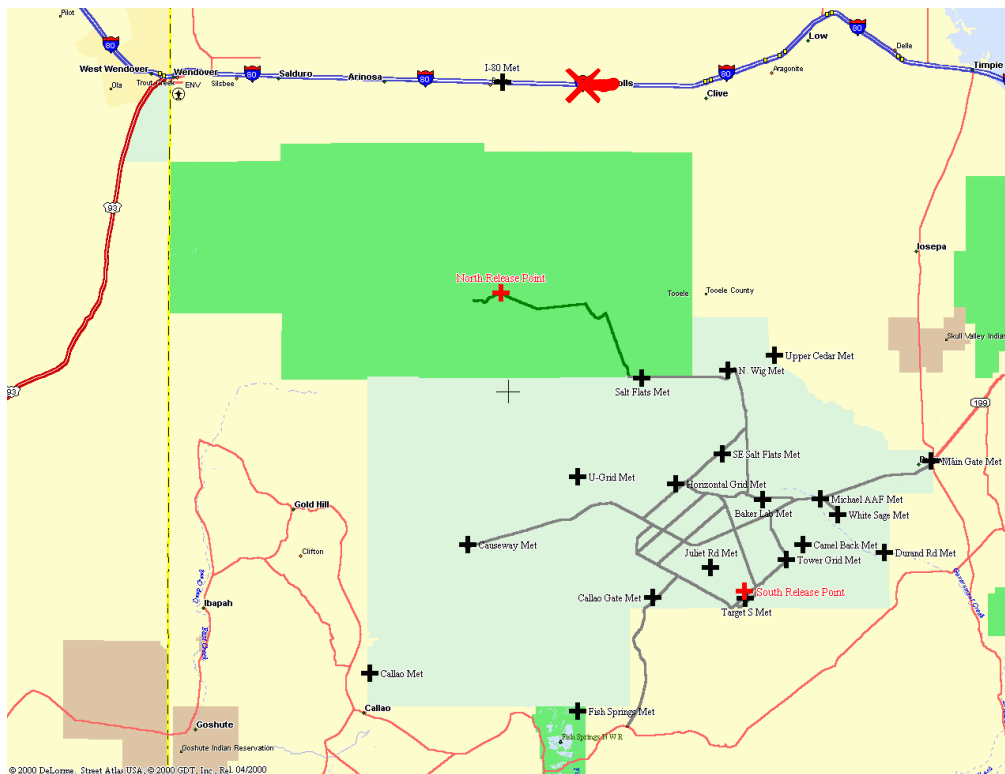
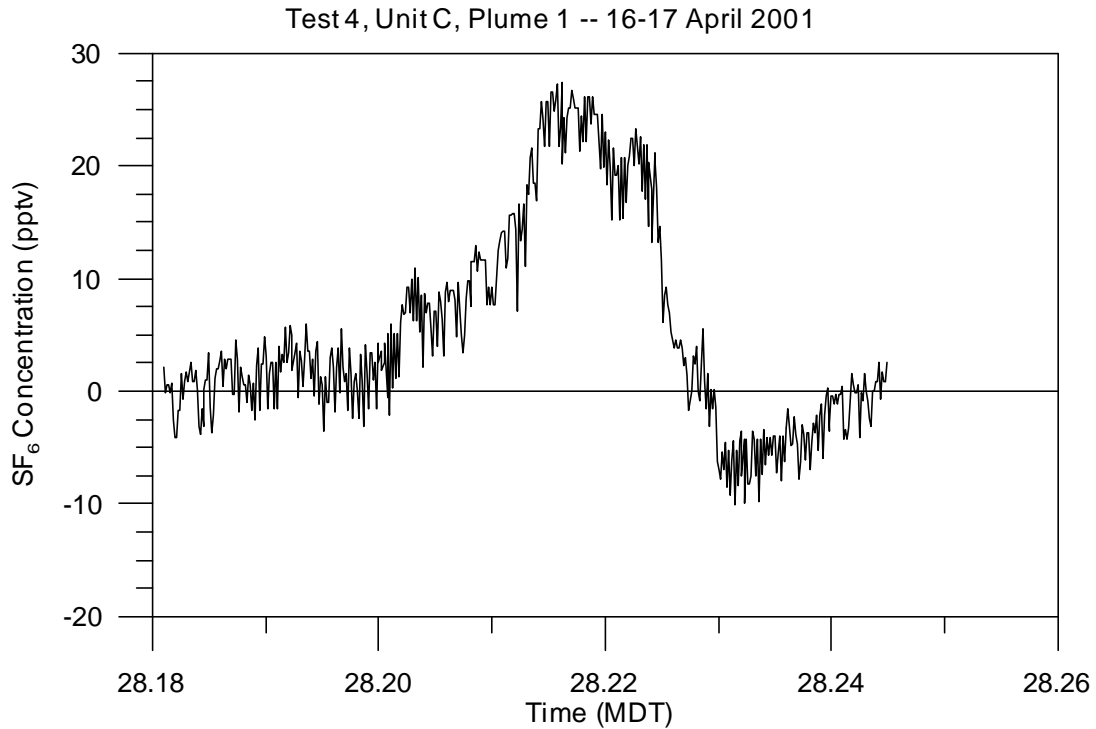


Figure A-153. SF₆ concentration of Plume 1 for Sampling Unit C during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

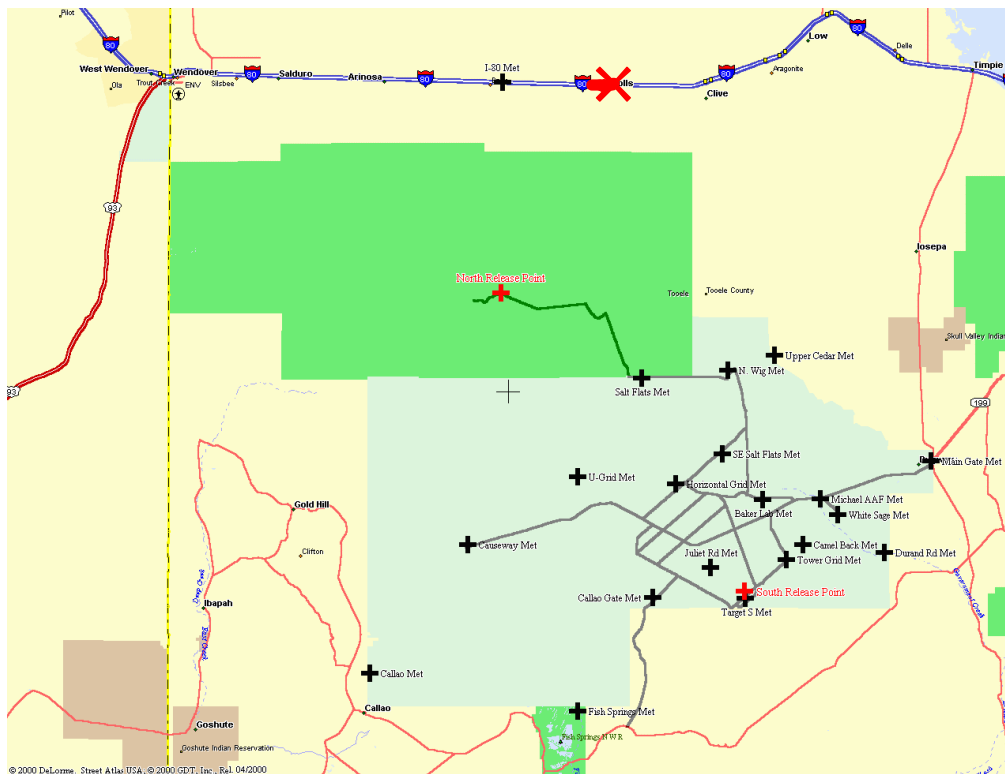
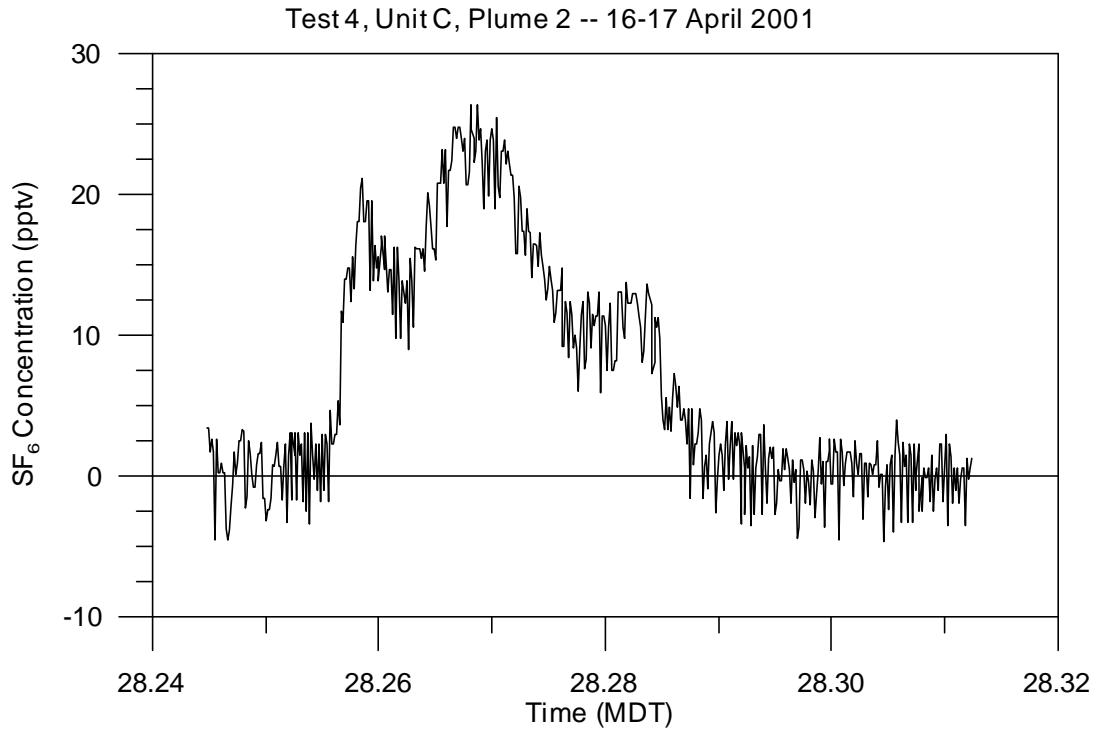


Figure A-154. SF₆ concentration of Plume 2 for Sampling Unit C during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

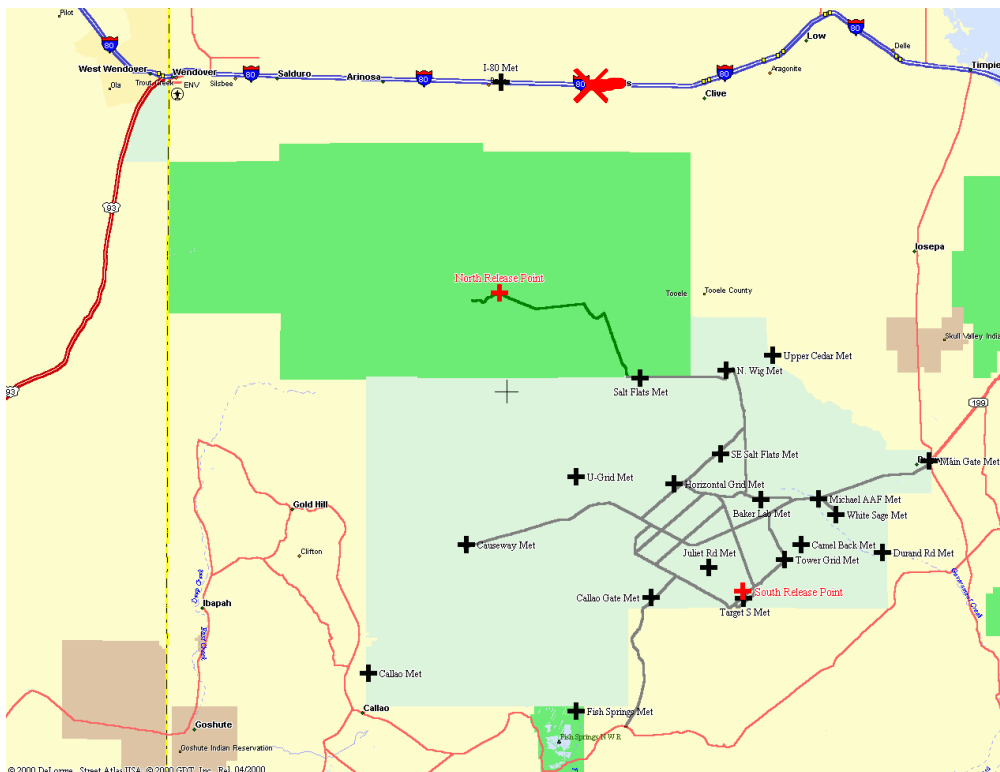
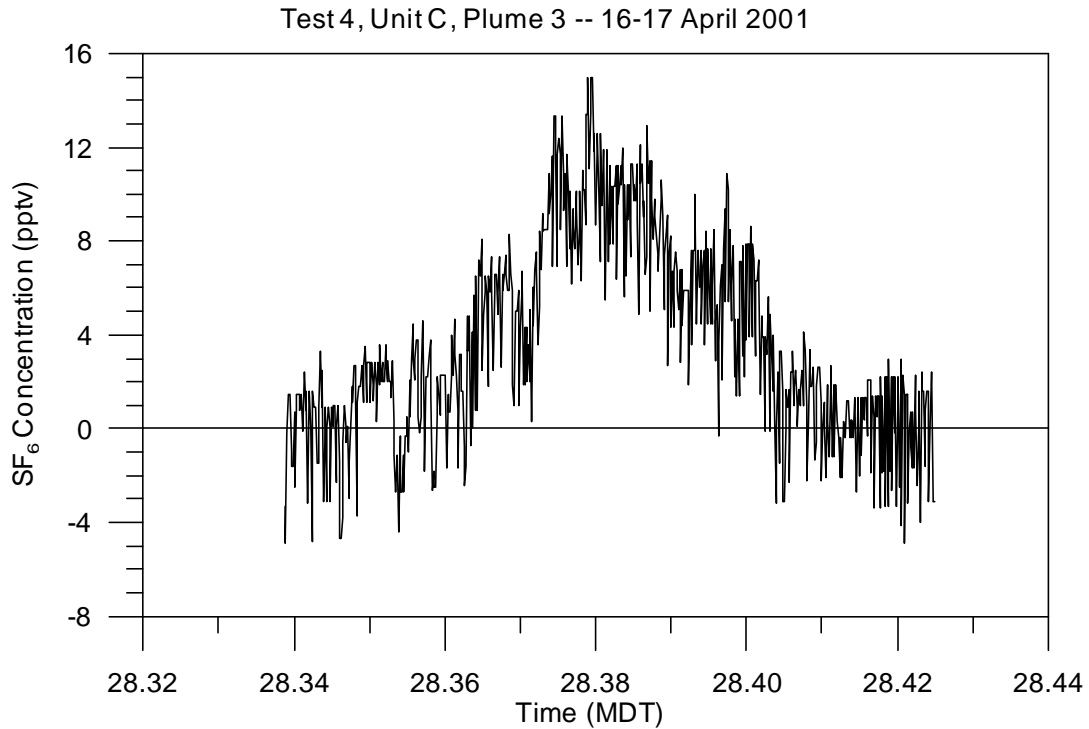


Figure A-155. SF₆ concentration of Plume 3 for Sampling Unit C during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

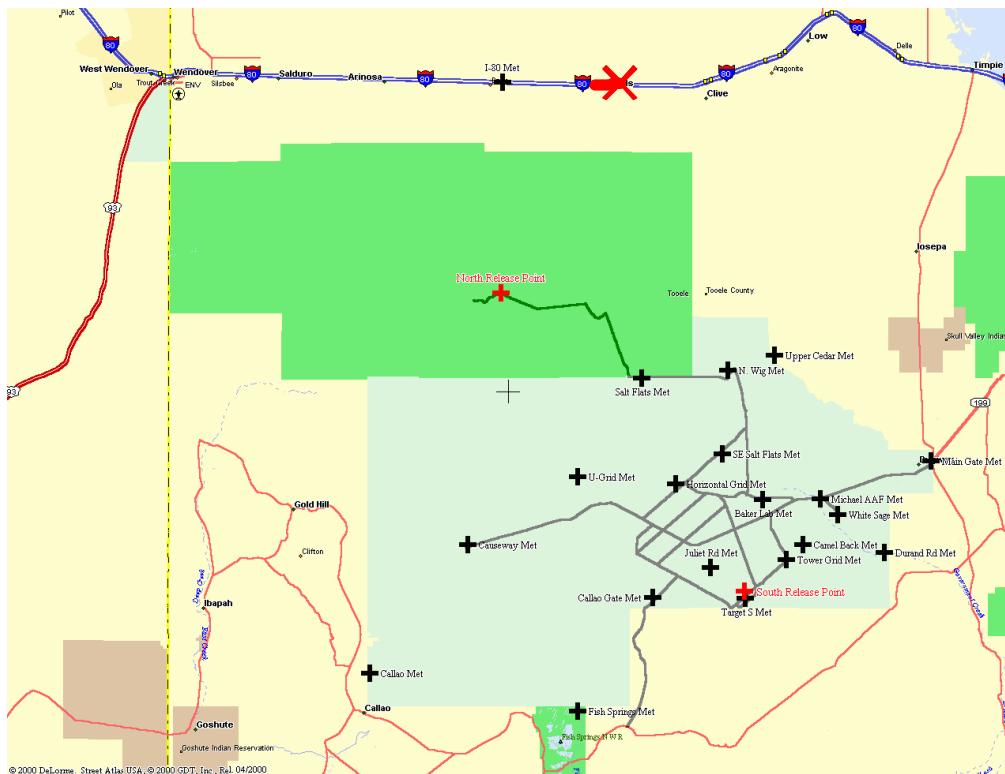
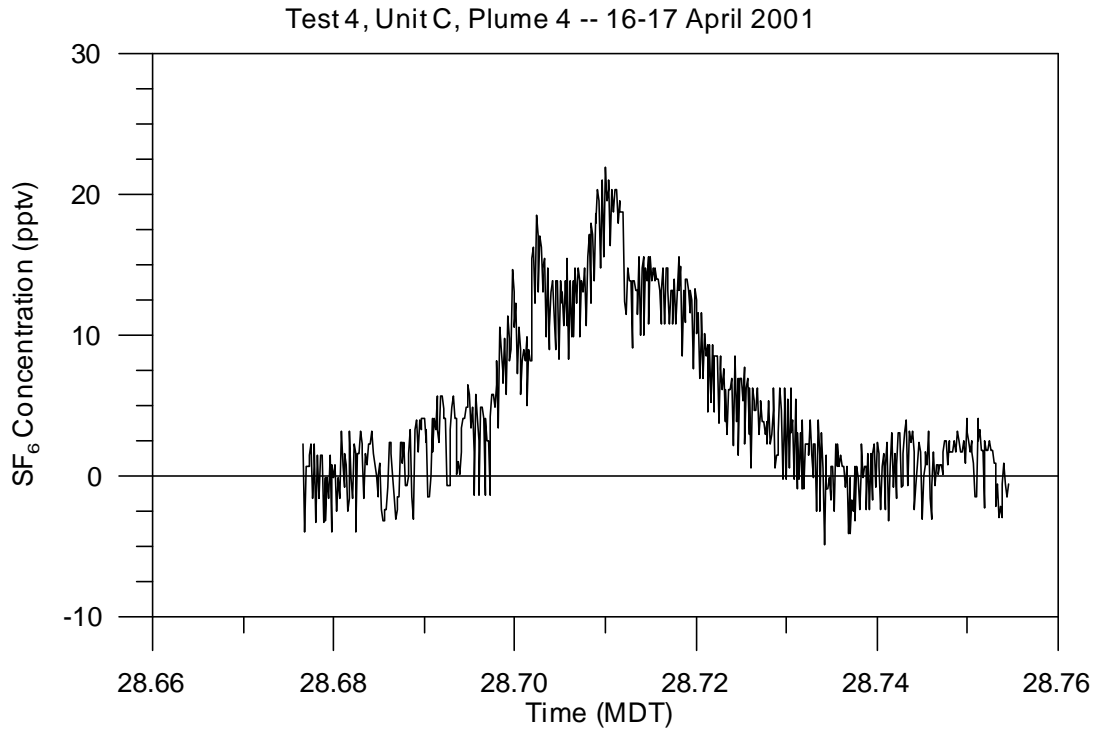


Figure A-156. SF₆ concentration of Plume 4 for Sampling Unit C during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

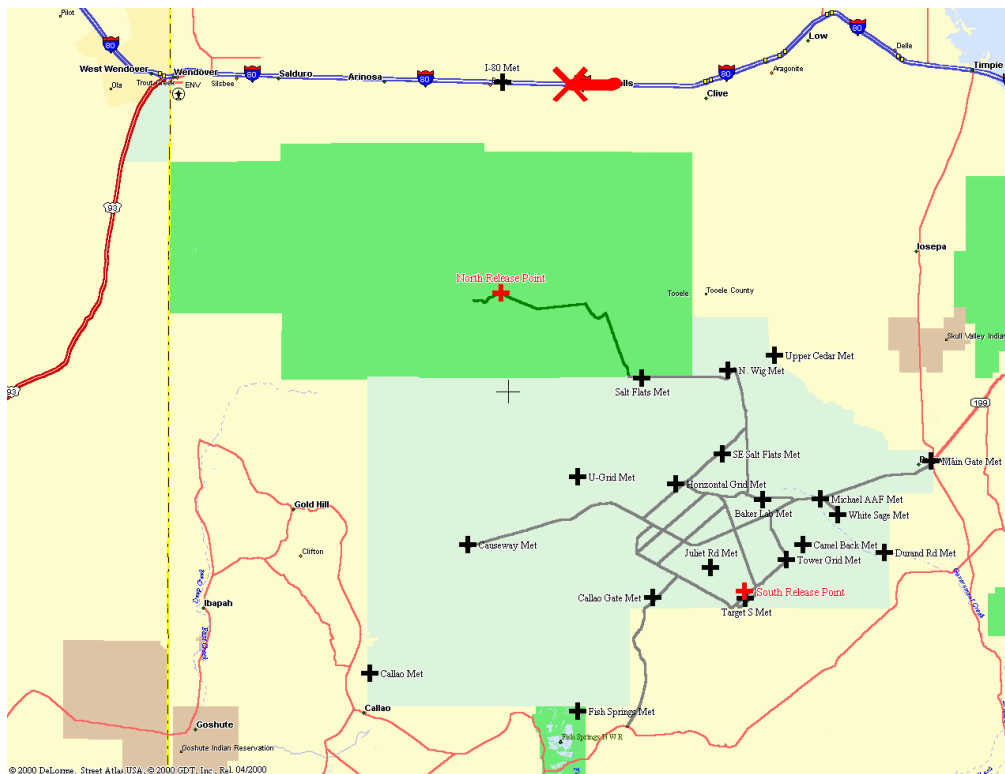
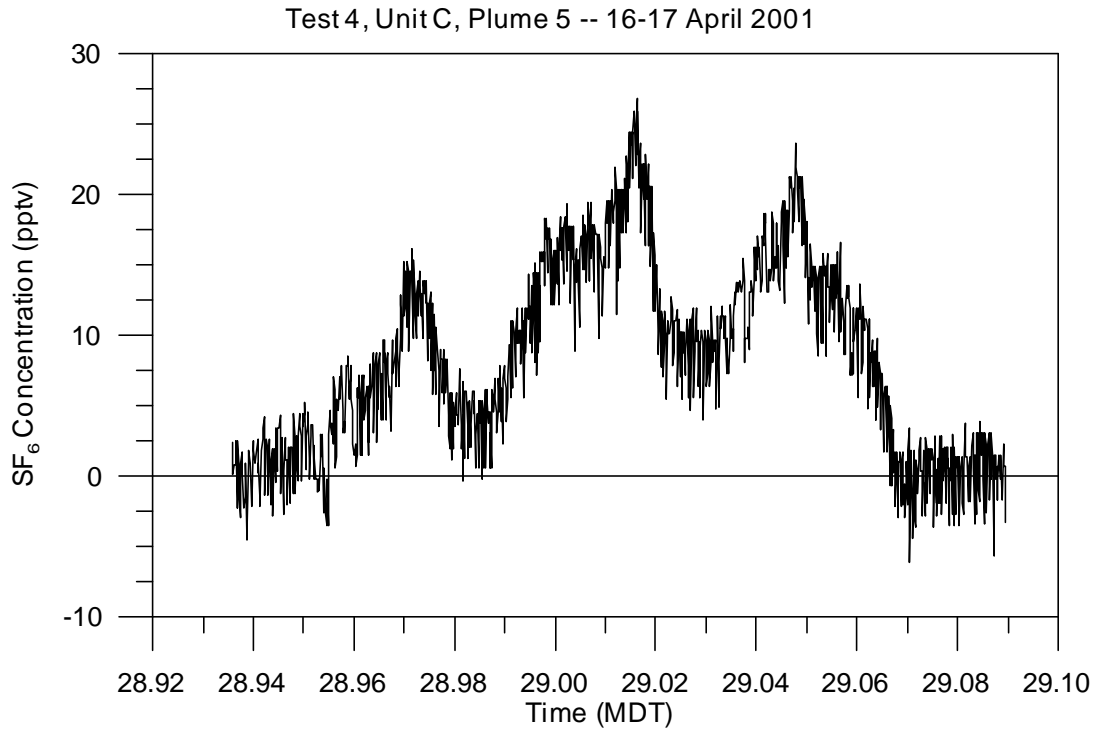


Figure A-157. SF₆ concentration of Plume 5 for Sampling Unit C during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

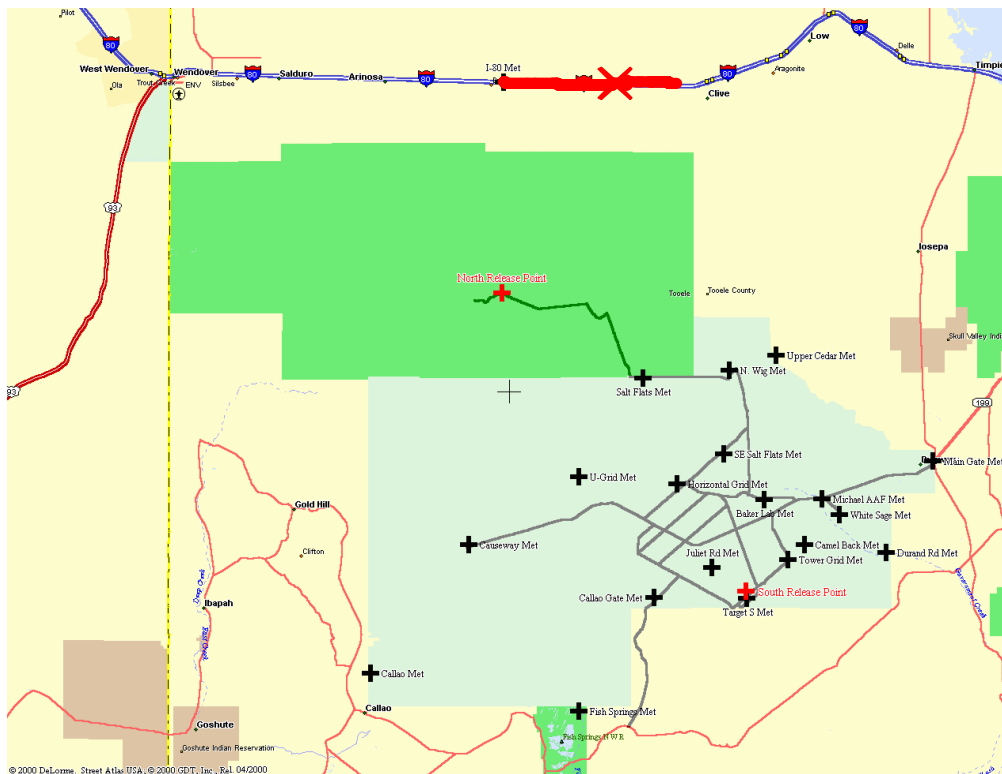
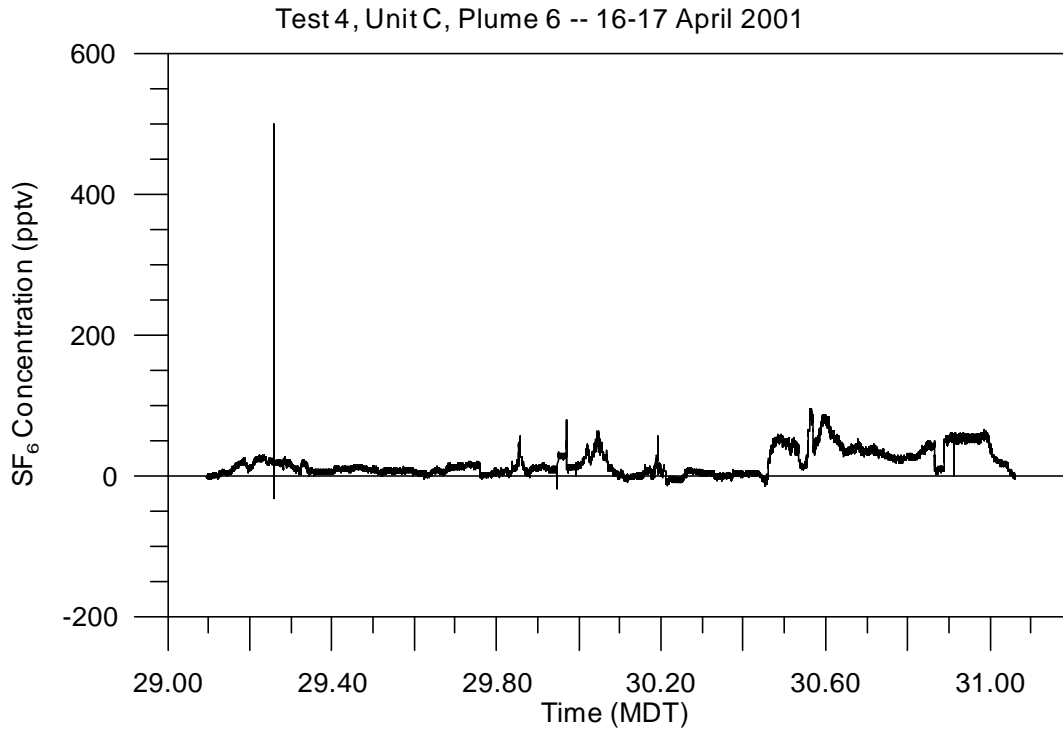


Figure A-158. SF₆ concentration of Plume 6 for Sampling Unit C during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

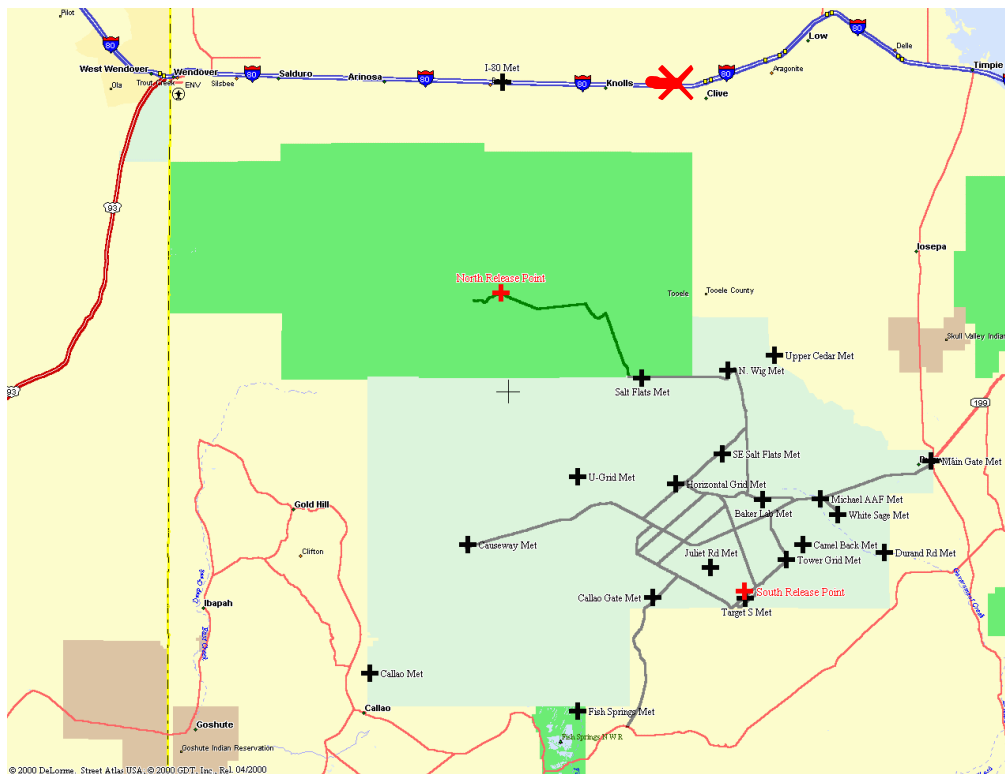
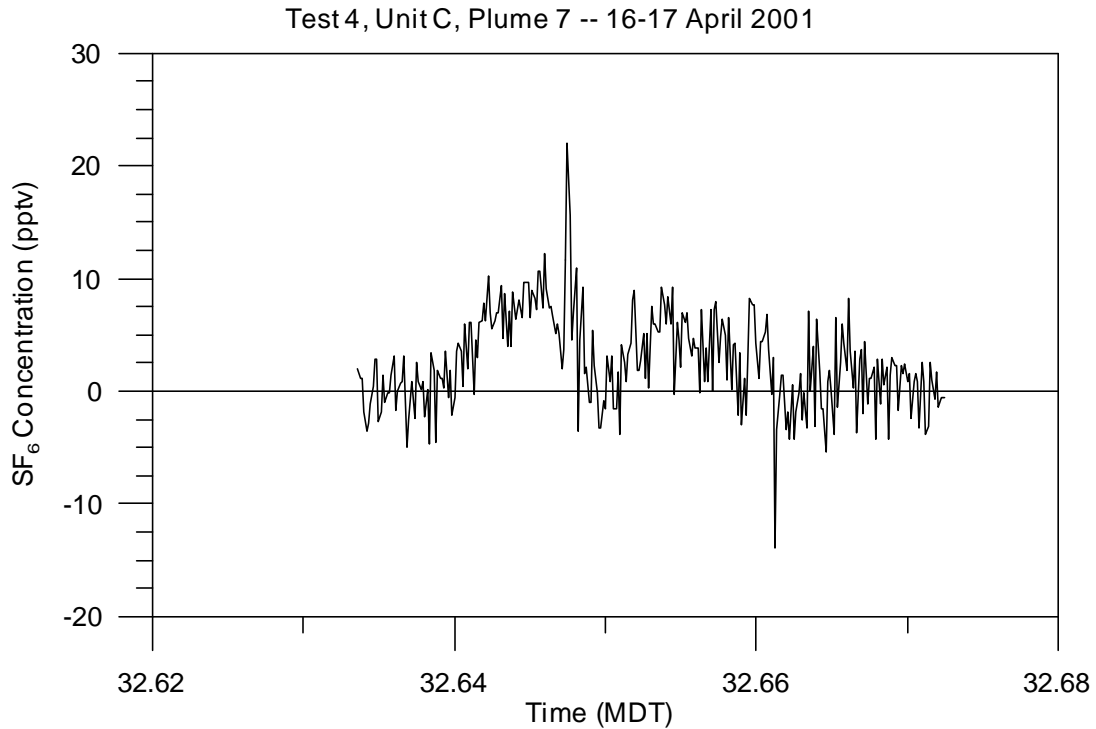


Figure A-159. SF₆ concentration of Plume 7 for Sampling Unit C during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

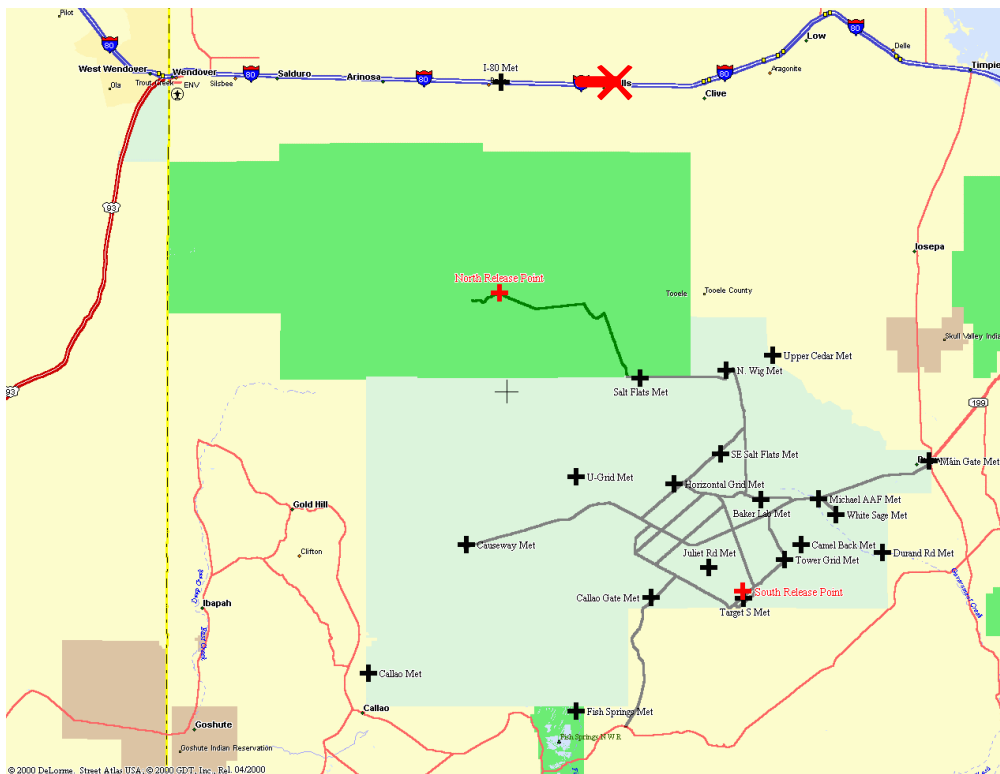
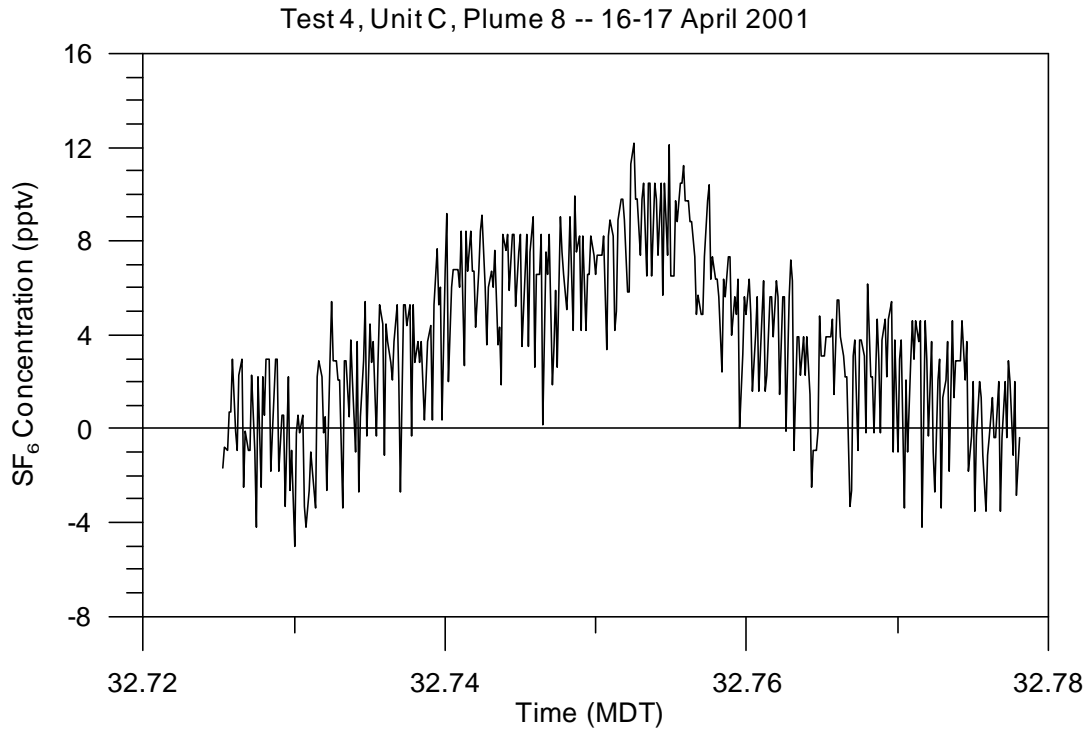


Figure A-160. SF₆ concentration of Plume 8 for Sampling Unit C during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

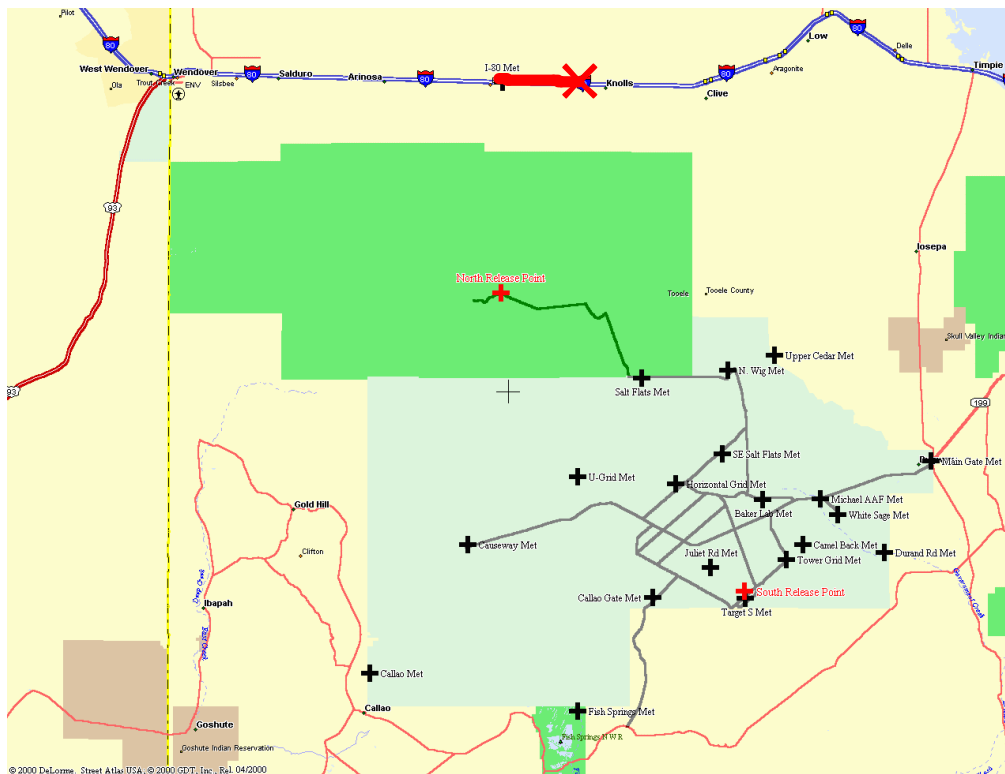
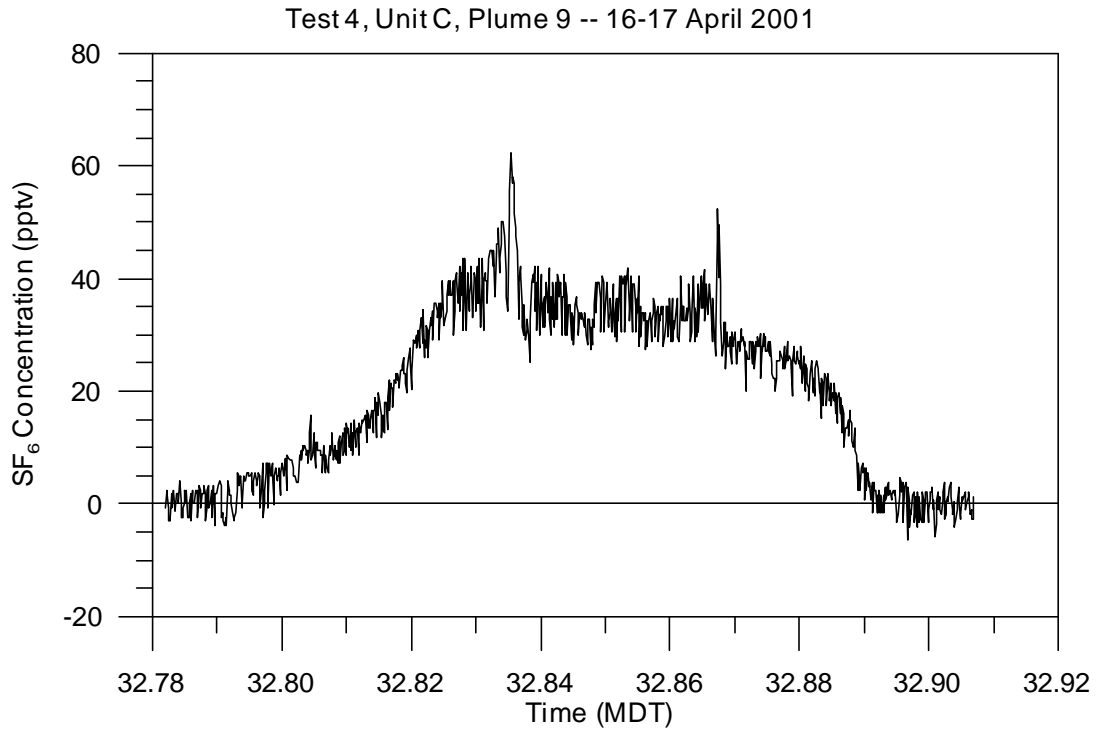


Figure A-161. SF₆ concentration of Plume 9 for Sampling Unit C during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

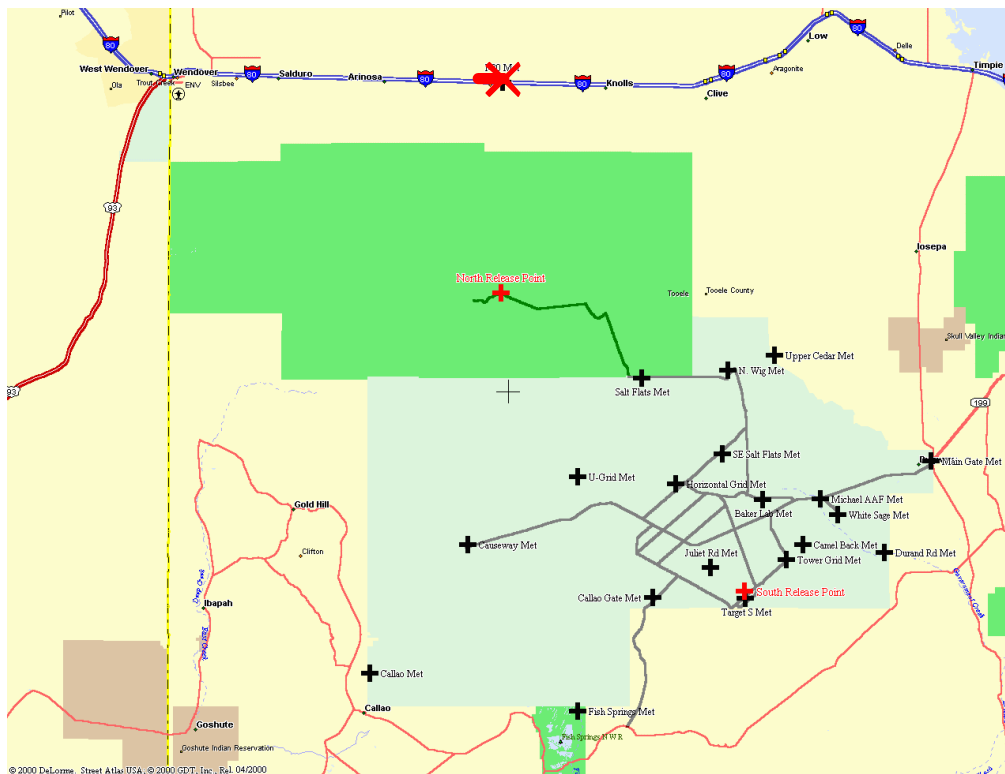
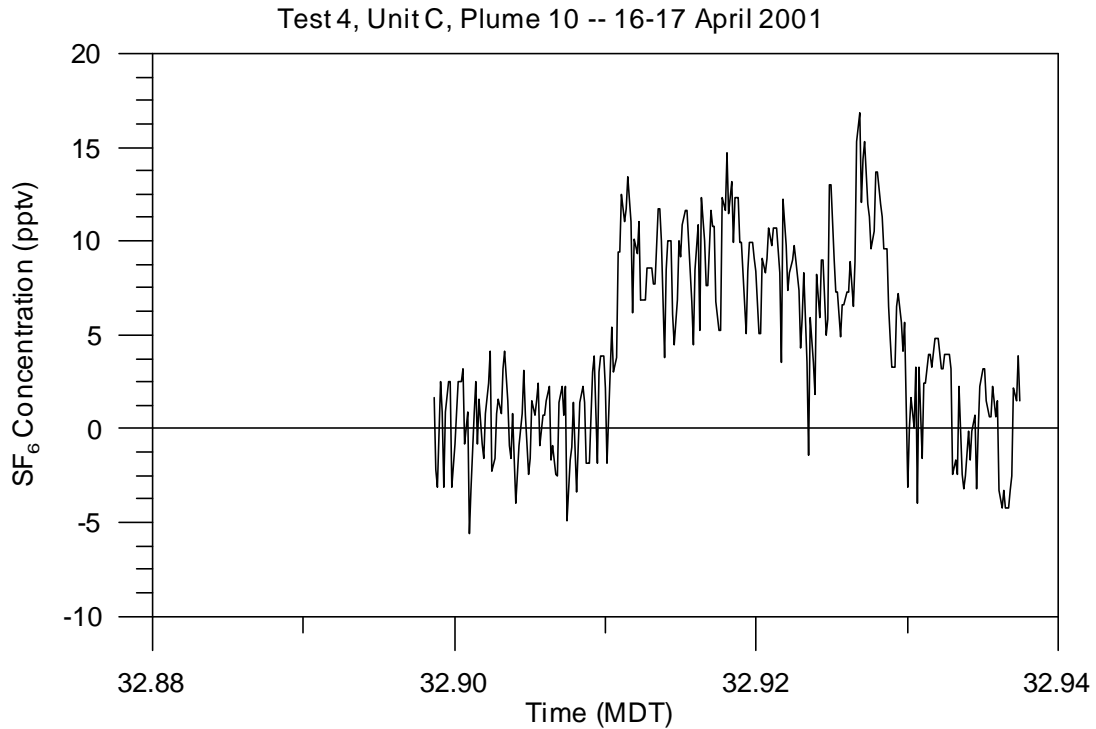


Figure A-162. SF₆ concentration of Plume 10 for Sampling Unit C during Test 4 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 5 Sampling Unit A

Table A-41. Test 5 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	22:56	23:19

Table A-42. Summary of individual SF₆ plume characteristics measured by Sampling Unit A during Test 5. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time* (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	23:21-23:31	1261	335.0-19.7	13.84	14.45	15.98
2	23:44-23:57	1576	322.0-10.6	13.84	15.12	17.20
3	24:09-24:17	916	318.6-350.5	14.05	15.92	17.66
4	24:32-24:40	901	315.7-344.4	14.65	16.44	18.19
5	24:50-24:59	1161	315.7-350.8	14.03	15.93	18.19
6	25:03-25:14	1301	317.7-352.4	13.95	15.55	17.83
7	25:22-25:31	1081	320.6-344.0	17.87	18.49	19.63
8	25:48-25:53	663	325.2-342.6	17.96	18.51	19.42
9	26:01-26:09	941	323.0-346.5	17.90	18.72	20.05
10	26:18-26:25	825	320.5-345.2	17.87	18.55	19.82
11	26:30-26:44	1635	319.4-346.5	17.87	18.83	20.04
12	26:47-26:58	1344	317.5-346.4	17.86	18.59	20.02
13	27:05-27:19	1642	317.4-343.8	17.86	18.22	19.60
14	27:54-28:05	1332	317.0-346.5	17.87	18.50	20.04

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

Table A-43. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit A during Test 5.

Plume Number	Concentration (pptv)	Time* (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	479.8	23:23	40.185685	113.096877	344.5	14.63
2	687.8	23:55	40.186055	113.147835	329.7	16.37
3	622.3	24:11	40.184528	113.156505	327.2	16.62
4	853.2	24:38	40.179812	113.179528	320.8	17.35
5	745.6	24:51	40.178627	113.185137	319.4	17.55
6	822.5	25:12	40.183712	113.161022	326.0	16.75
7	799.3	25:24	40.193743	113.167873	326.4	18.00
8	330.7	25:53	40.196255	113.163953	327.8	18.05
9	326.9	26:03	40.200943	113.156825	330.3	18.19
10	324.9	26:23	40.196477	113.163612	327.9	18.06
11	233.3	26:33	40.191578	113.171072	325.3	17.96
12	202.4	26:53	40.202695	113.154088	331.2	18.24
13	150.8	27:13	40.197882	113.161468	328.7	18.10
14	19.3	28:03	40.220687	113.126692	340.3	19.11

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

Table A-44. Test 5 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) near the end of active SF₆ plume encounters.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
2	27:28	27:43

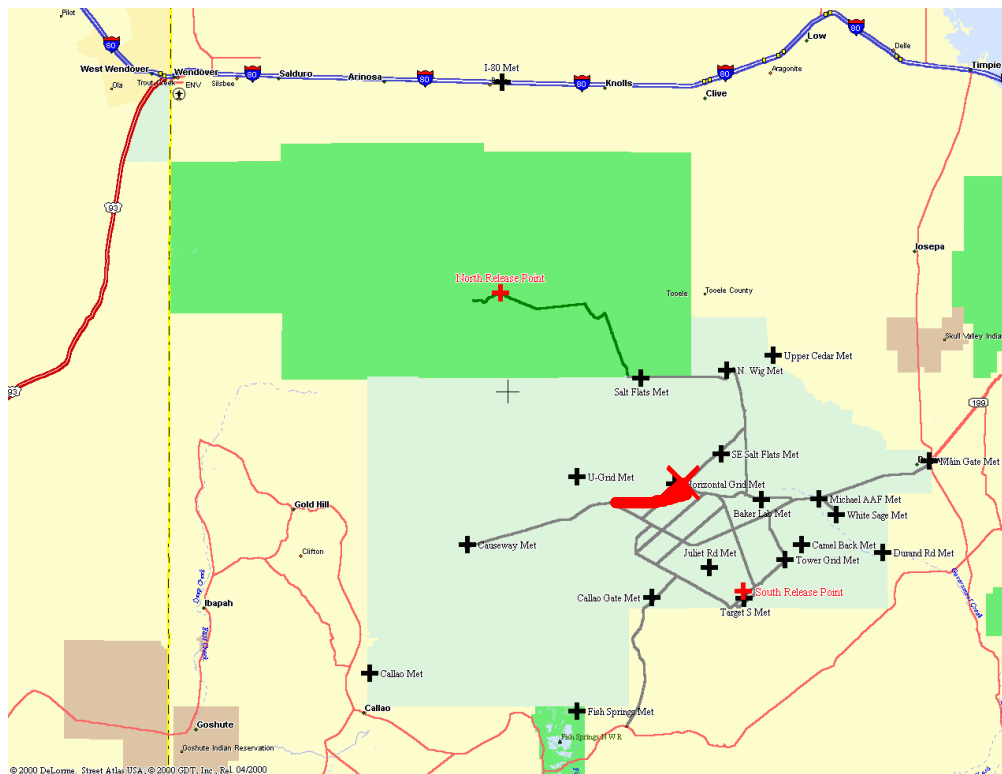
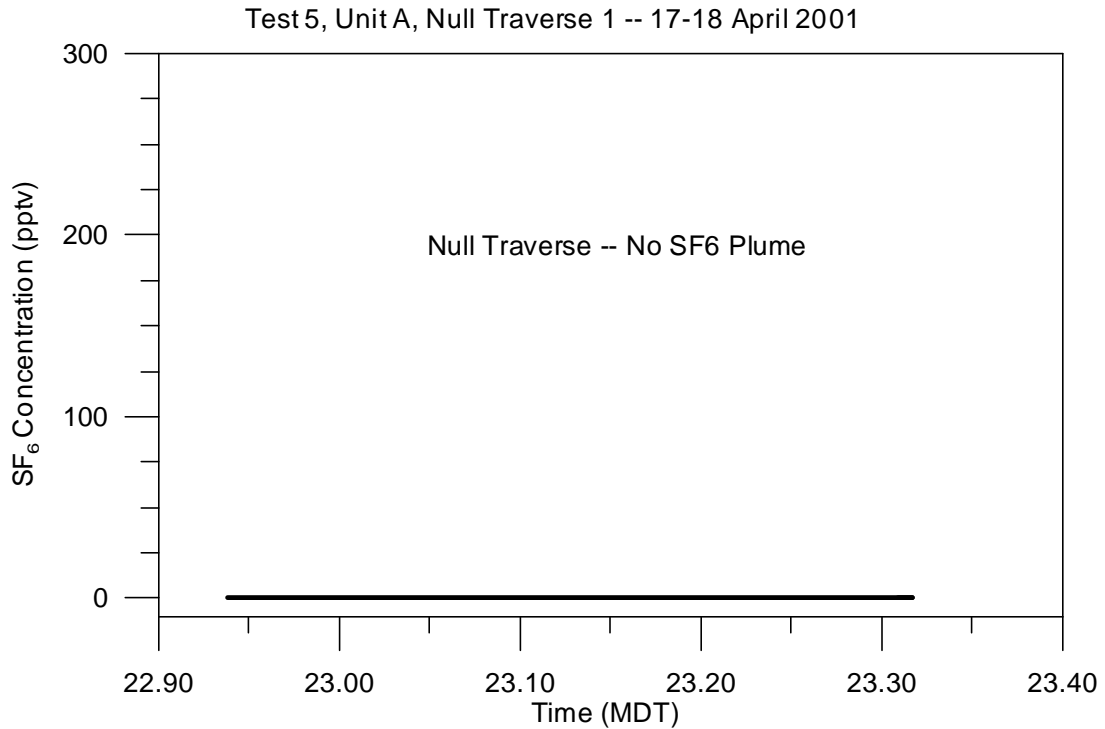


Figure A-163. Null sampling traverse 1 made by Sampling Unit A during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

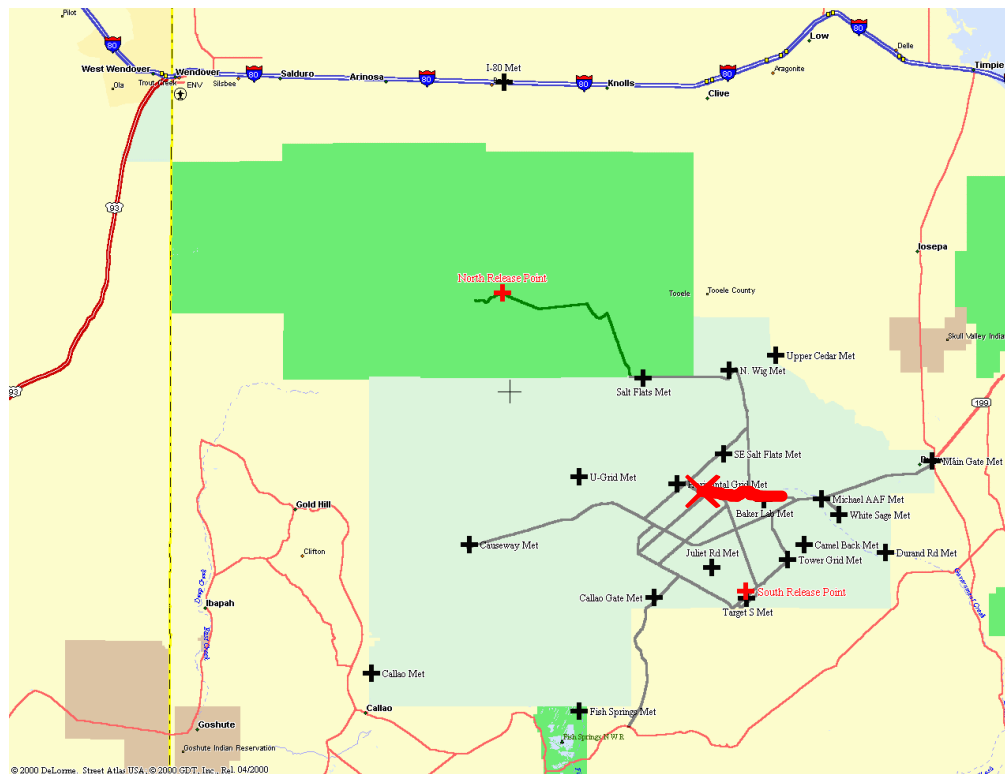
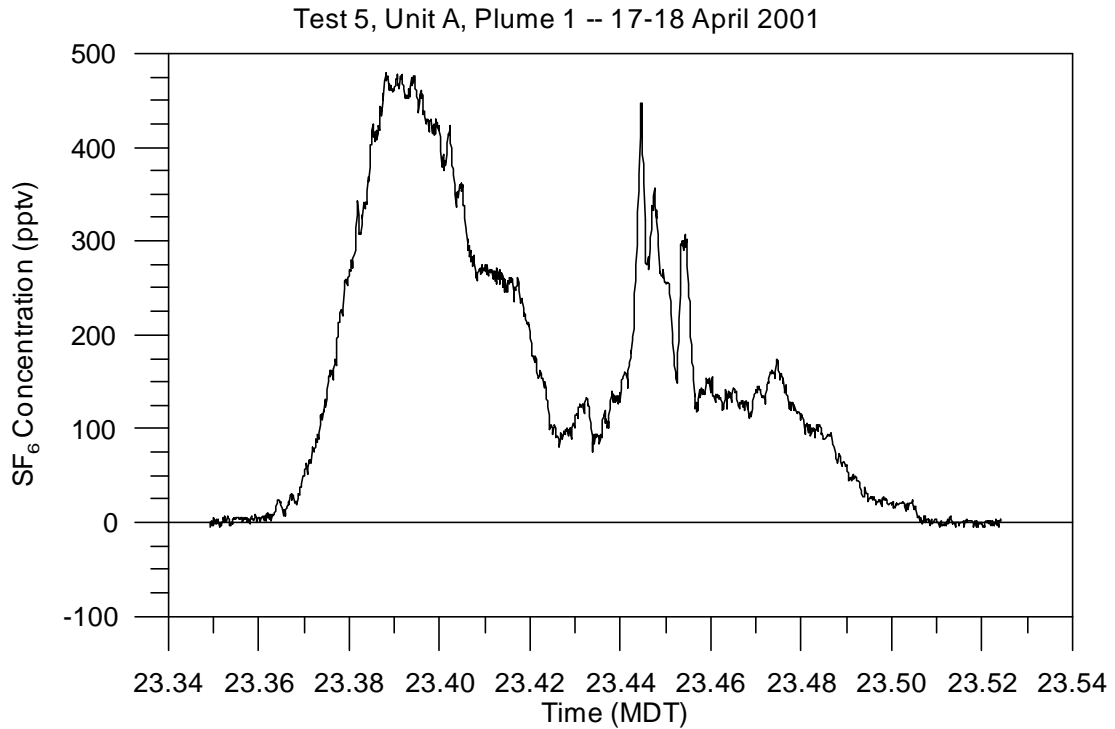


Figure A-164. SF₆ concentration of Plume 1 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

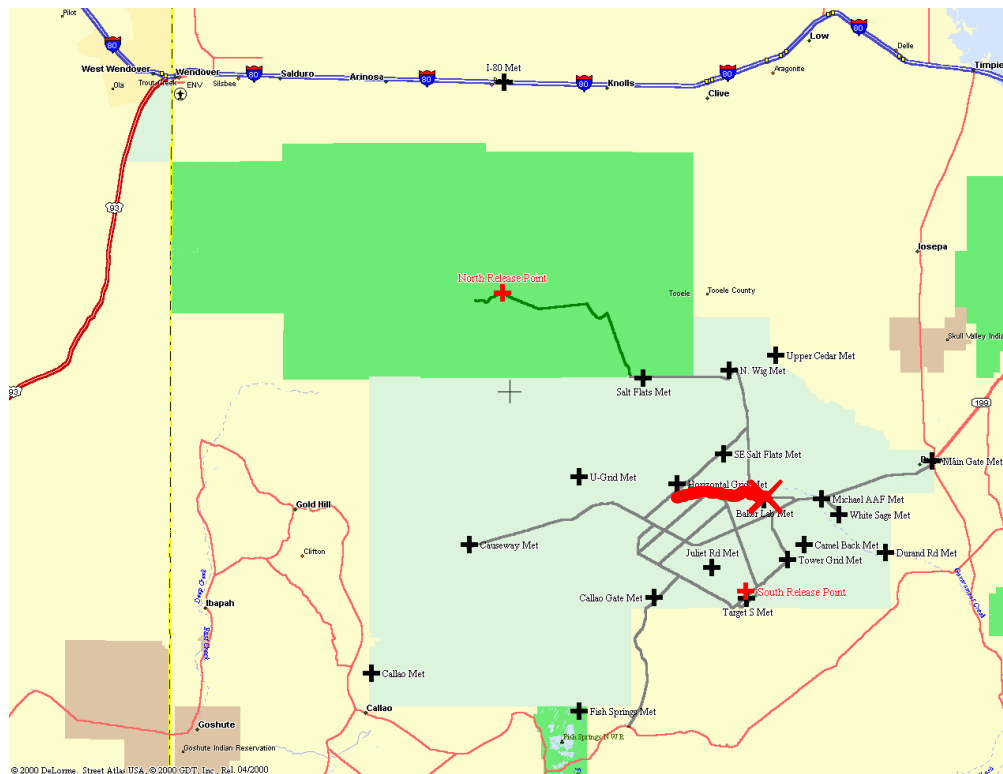
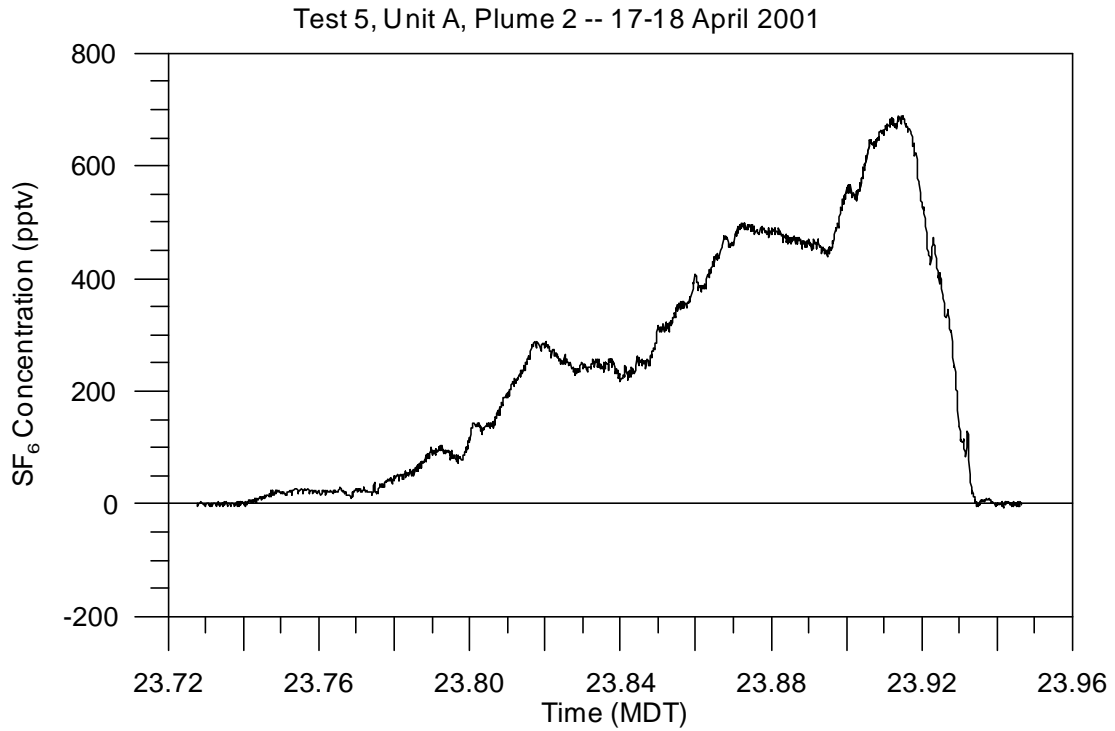


Figure A-165. SF₆ concentration of Plume 2 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

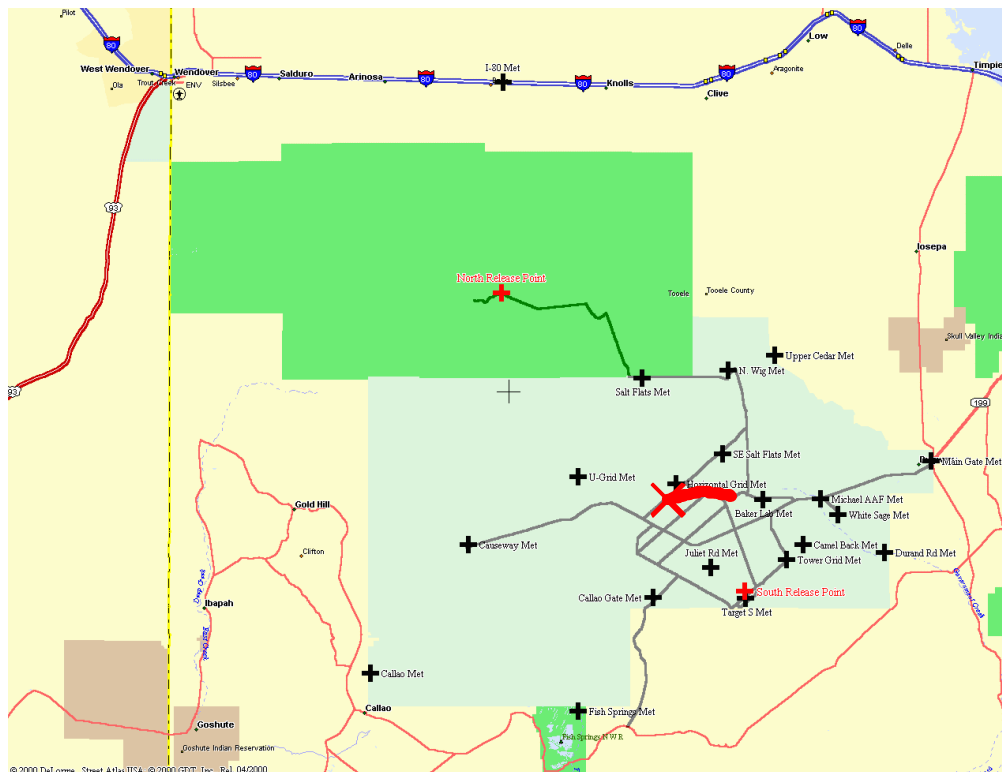
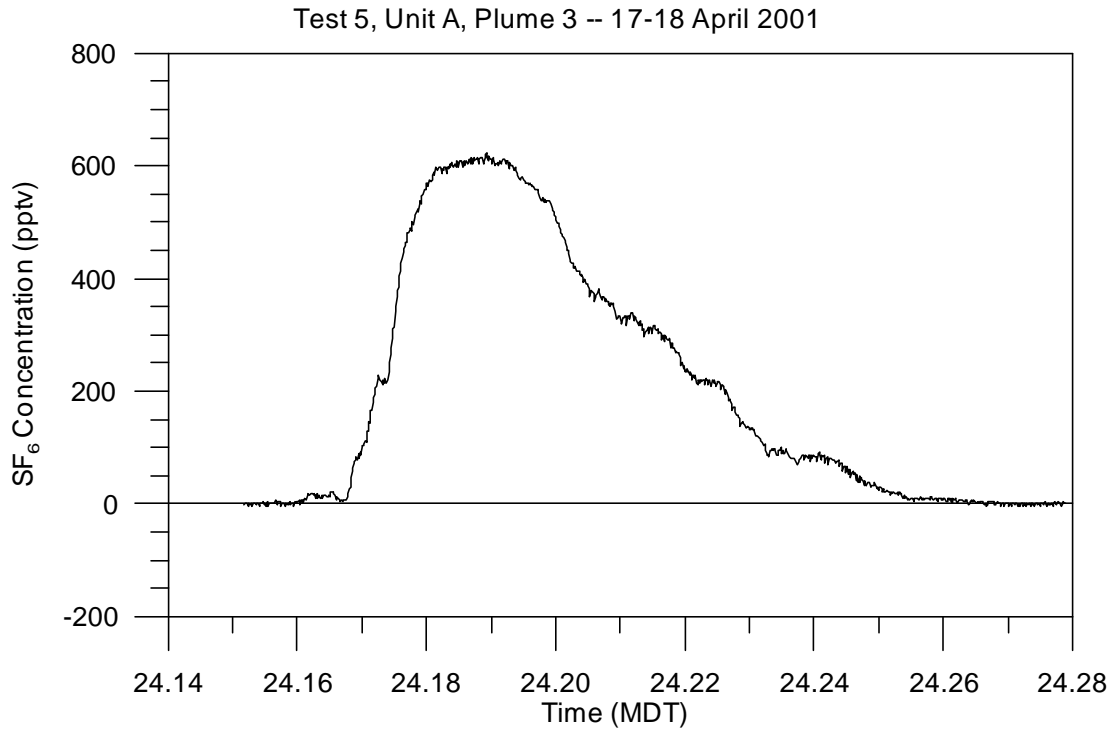


Figure A-166. SF₆ concentration of Plume 3 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

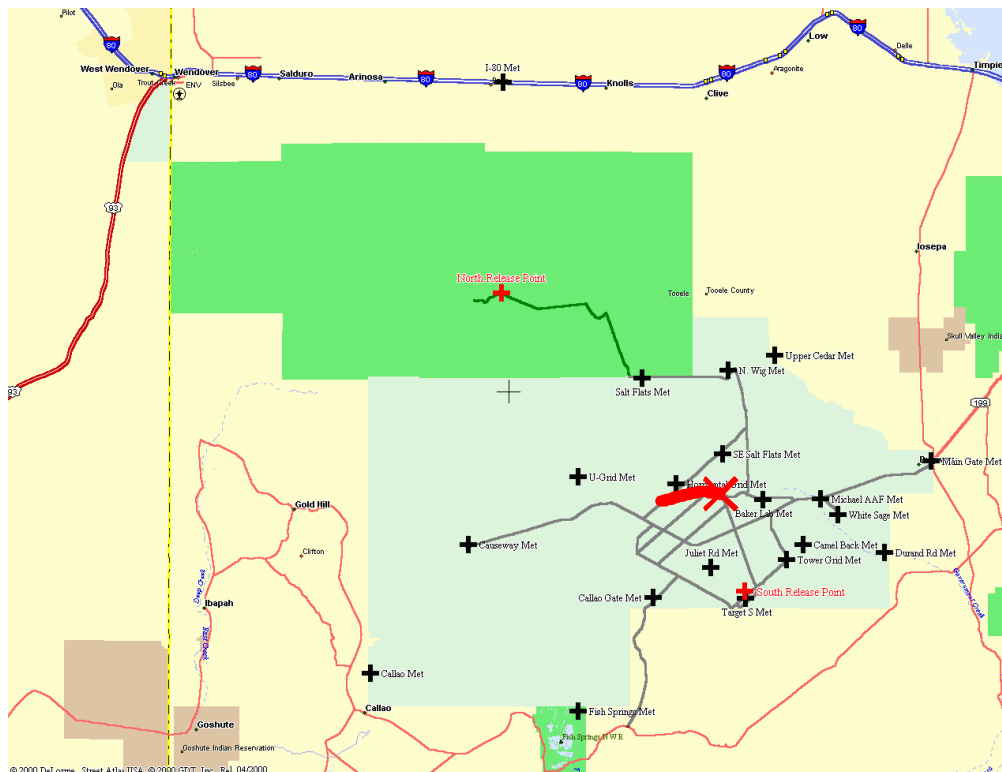
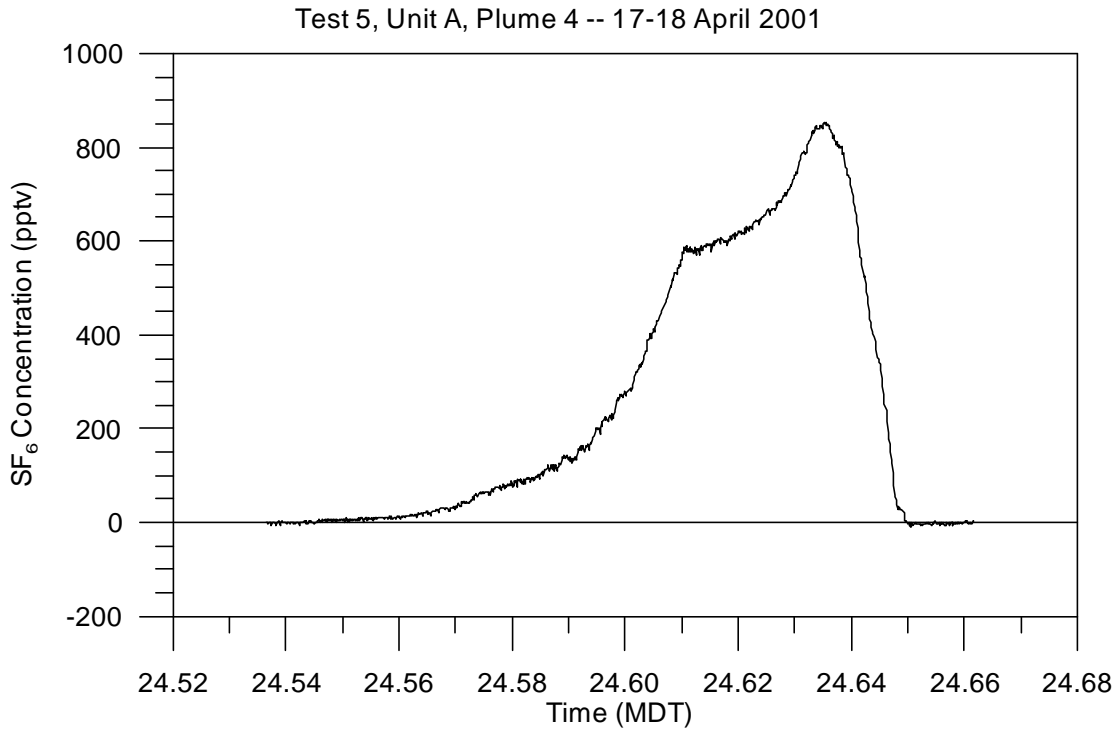


Figure A-167. SF₆ concentration of Plume 4 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

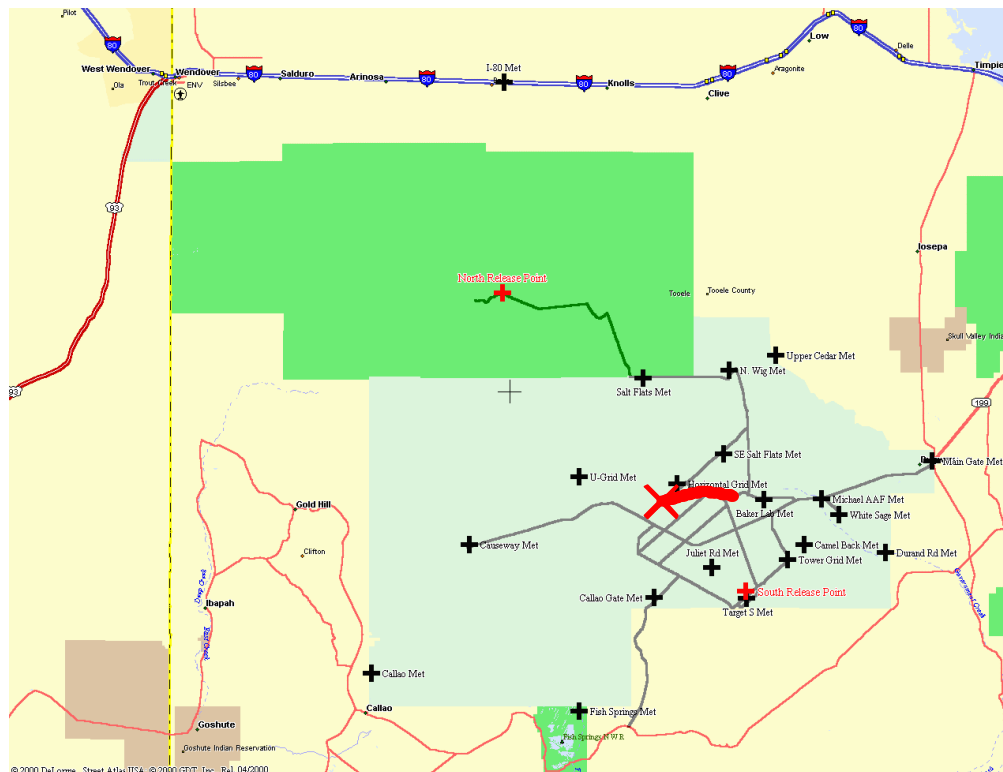
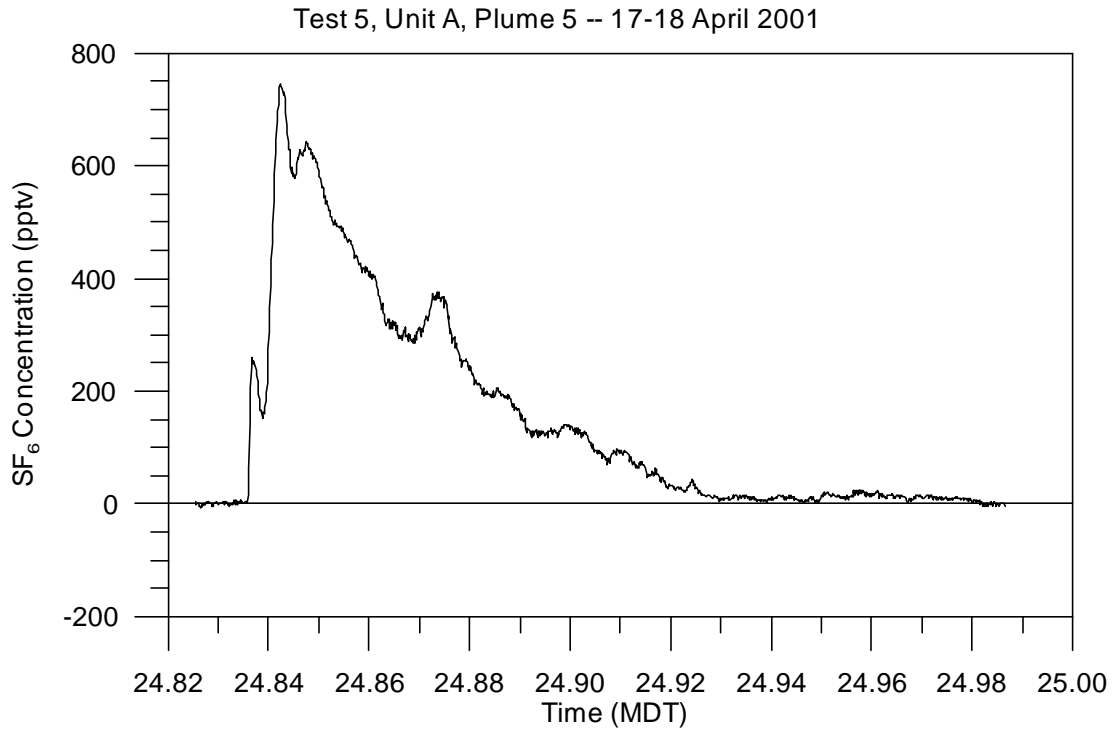


Figure A-168. SF₆ concentration of Plume 5 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

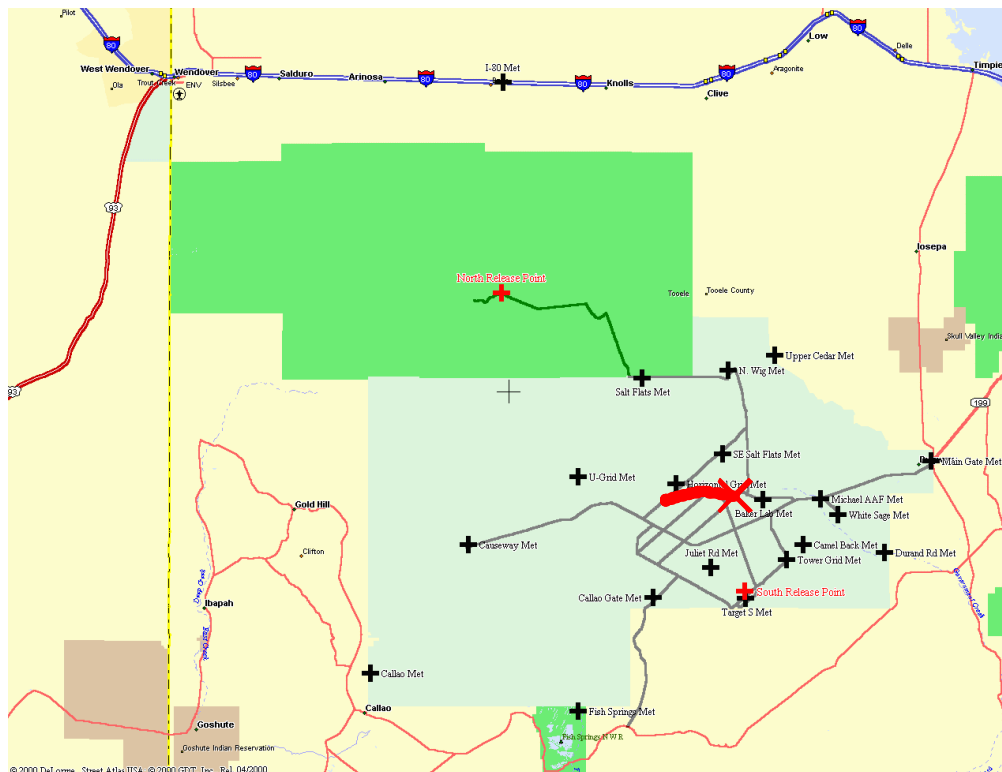
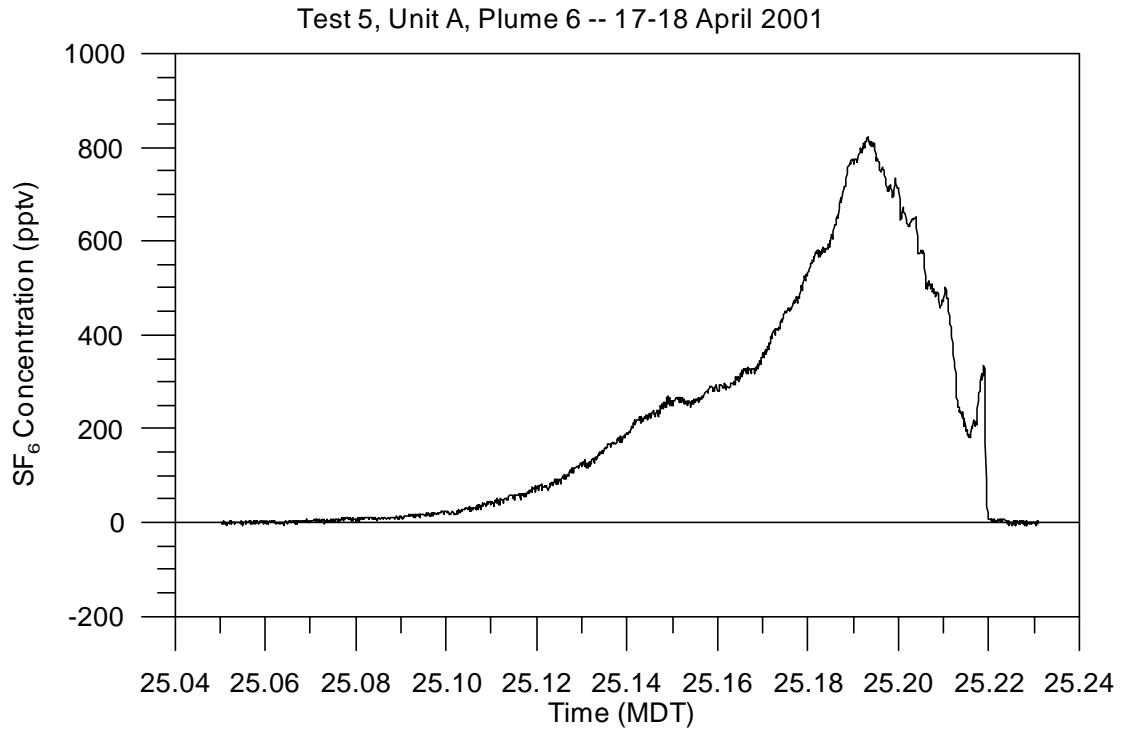


Figure A-169. SF₆ concentration of Plume 6 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

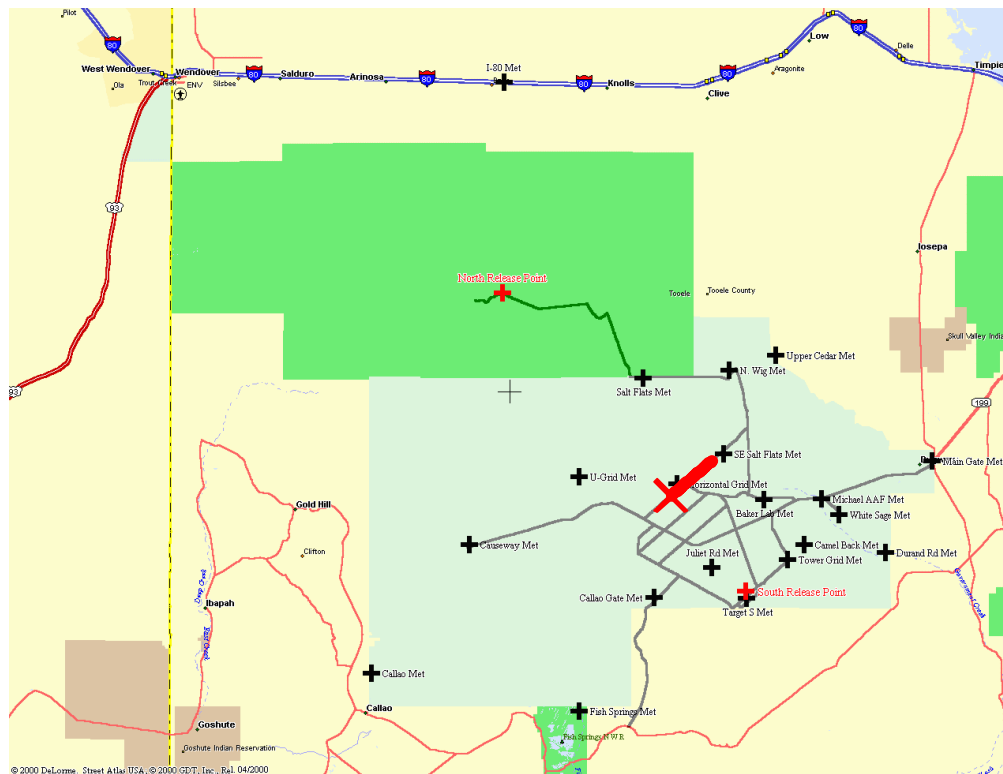
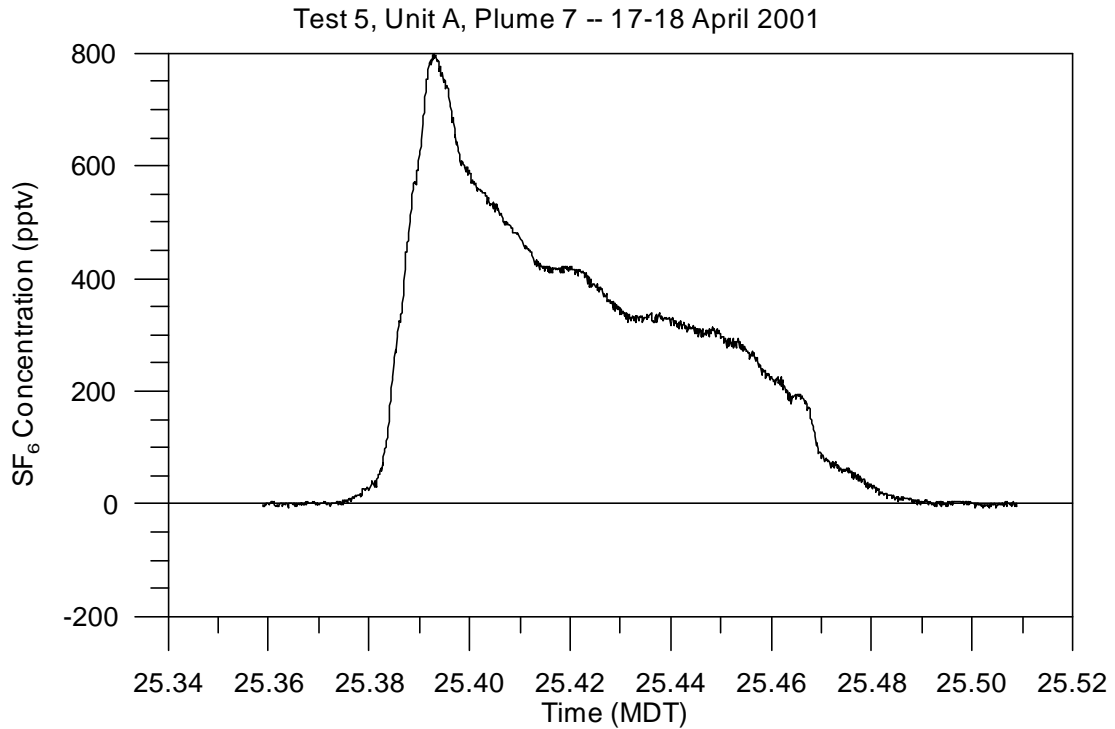


Figure A-170. SF₆ concentration of Plume 7 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

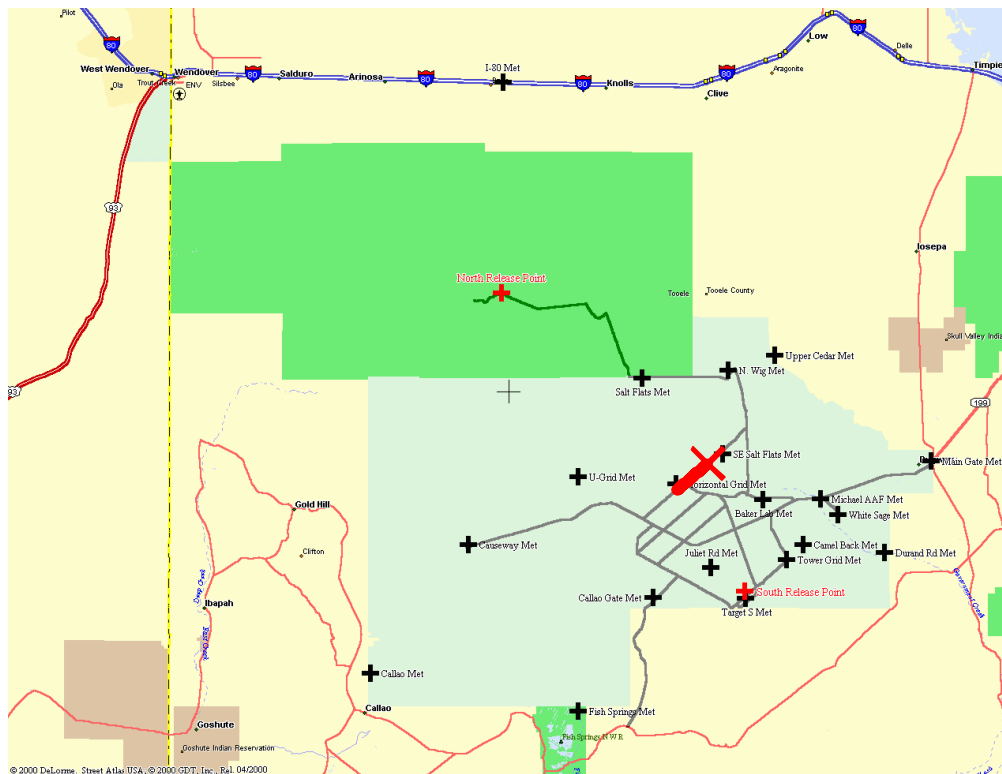
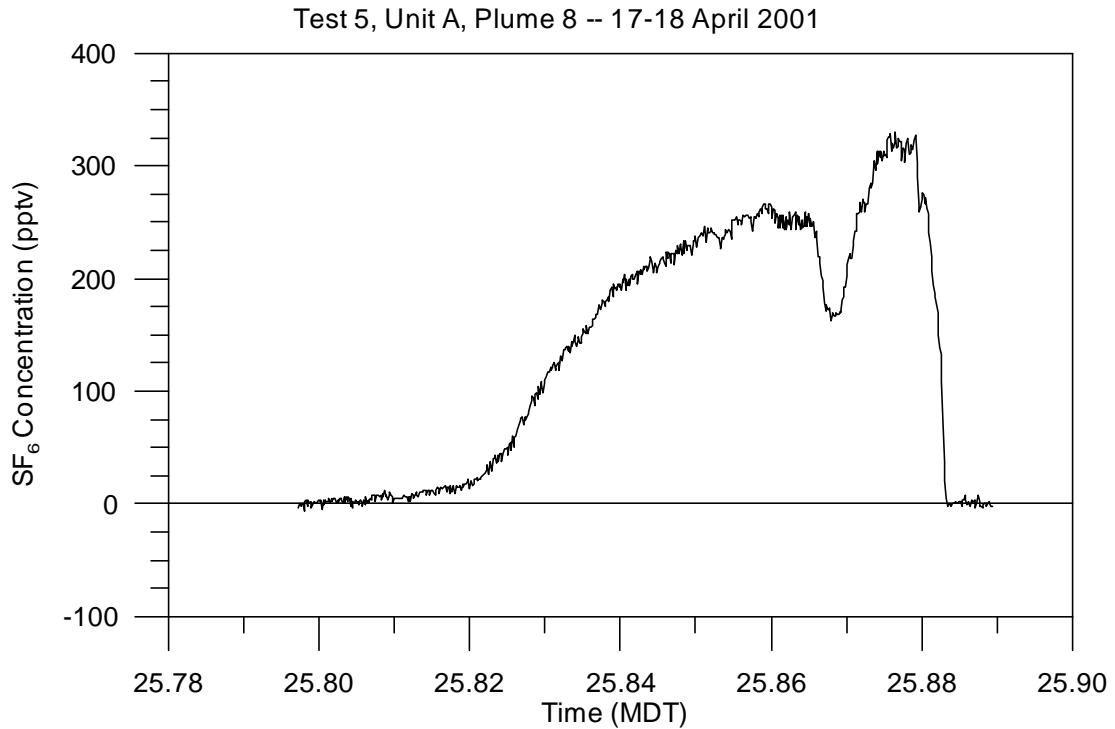


Figure A-171. SF₆ concentration of Plume 8 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

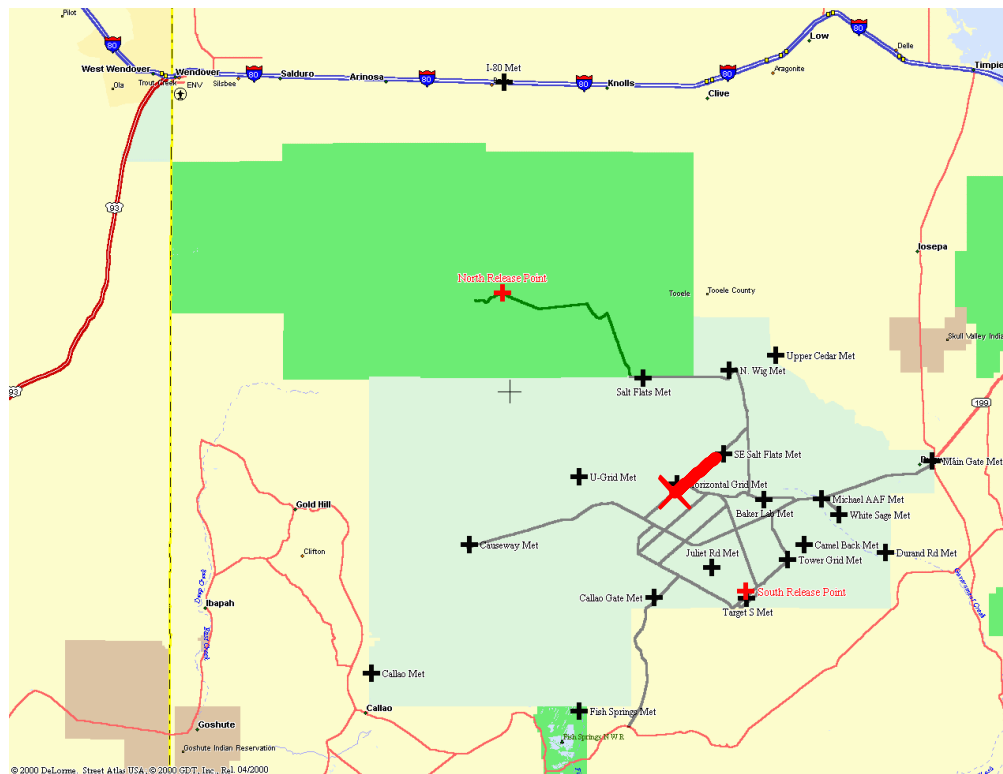
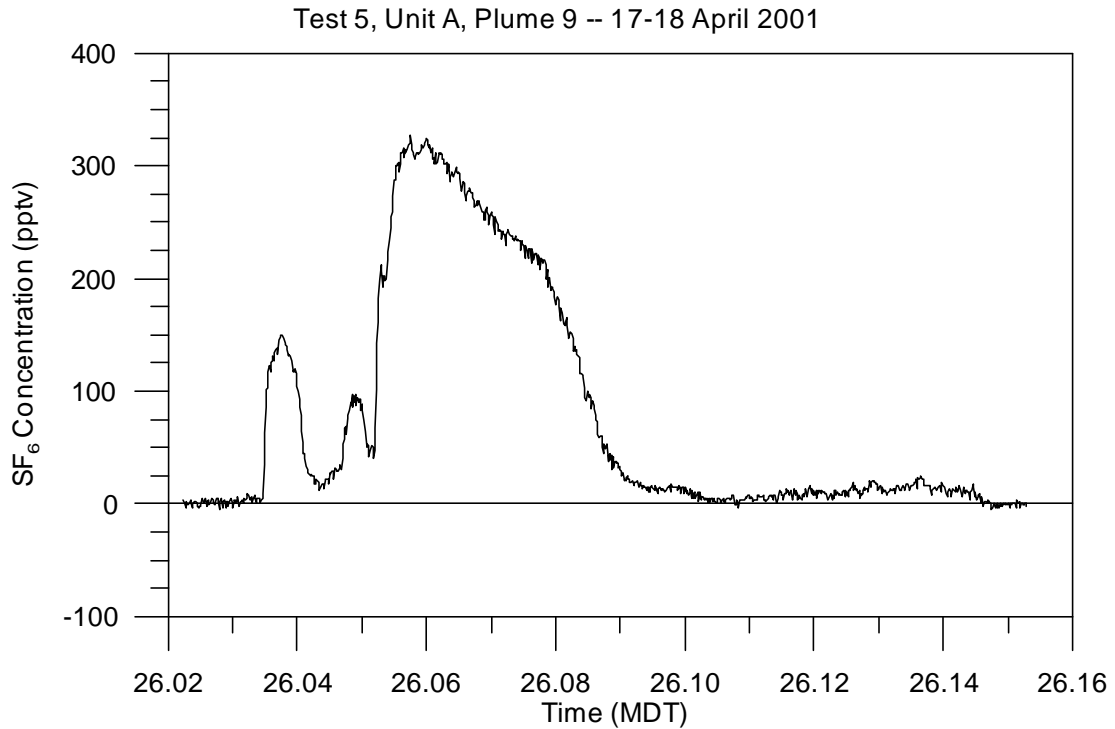


Figure A-172. SF₆ concentration of Plume 9 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

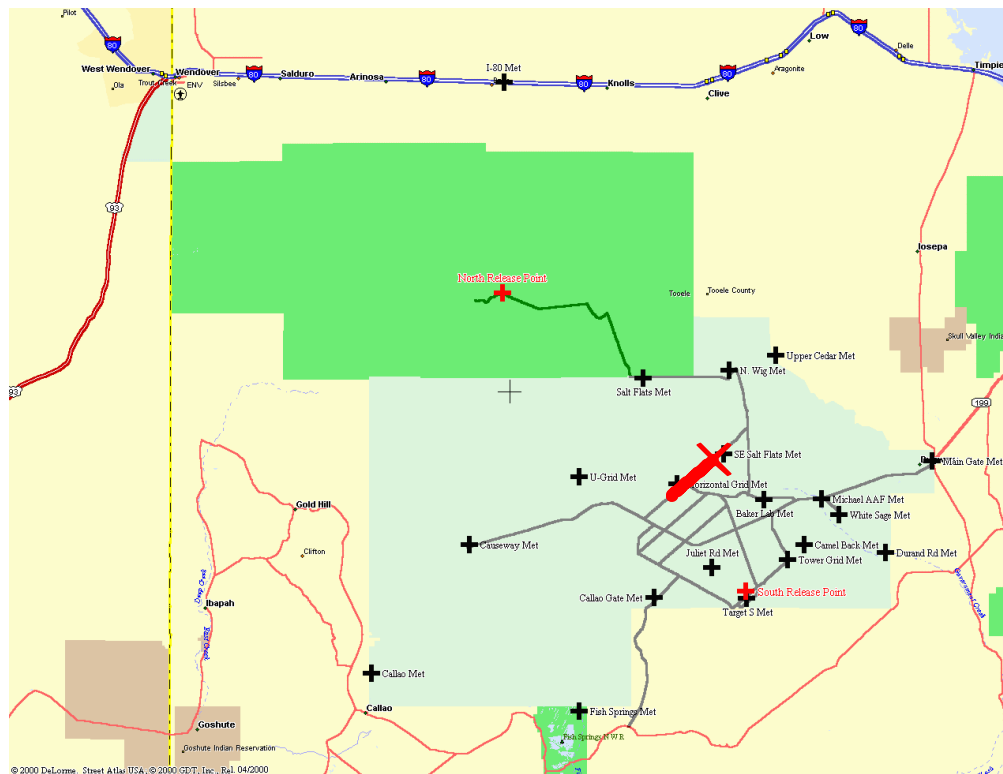
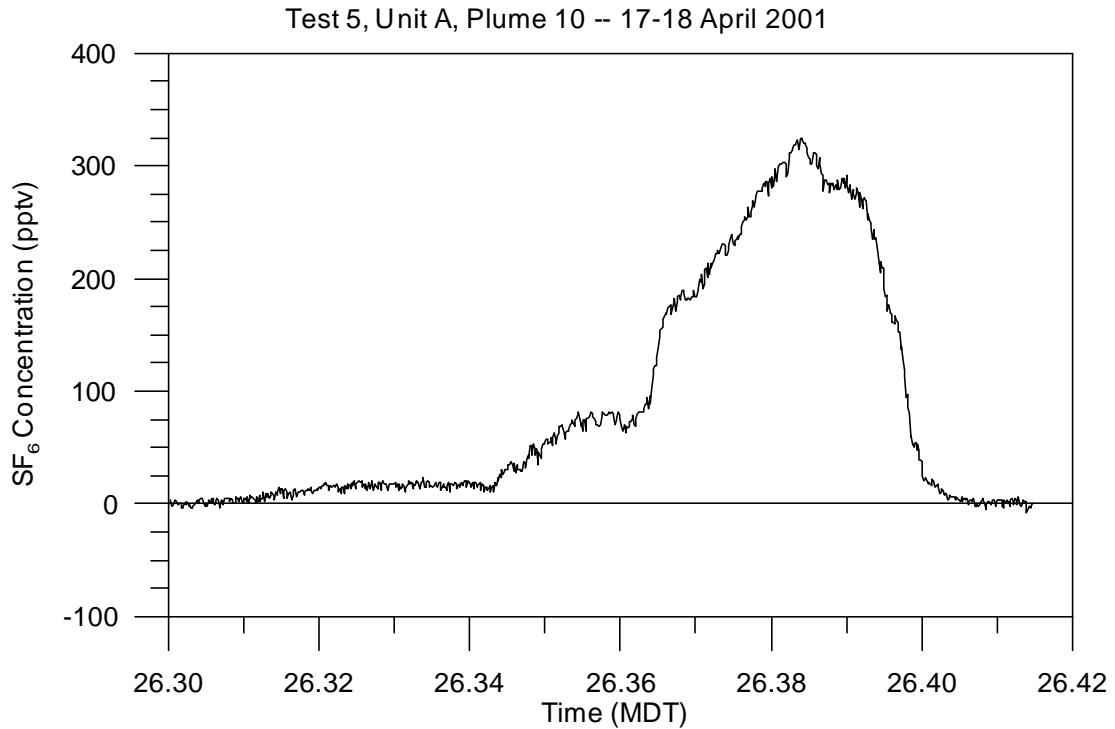


Figure A-173. SF₆ concentration of Plume 10 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

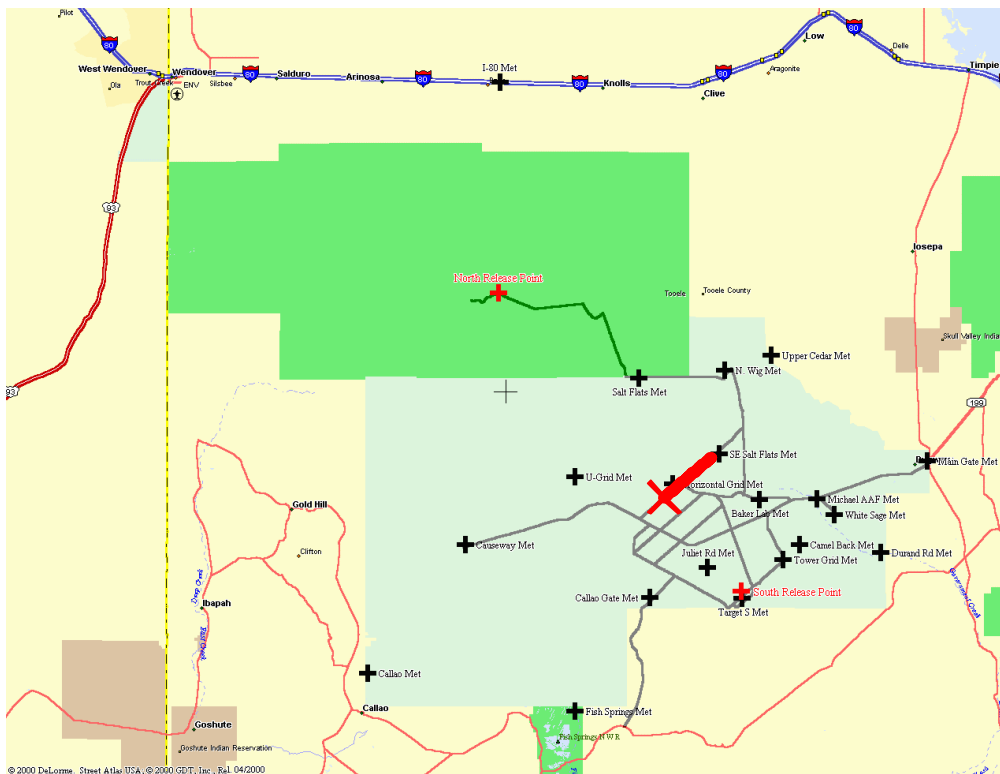
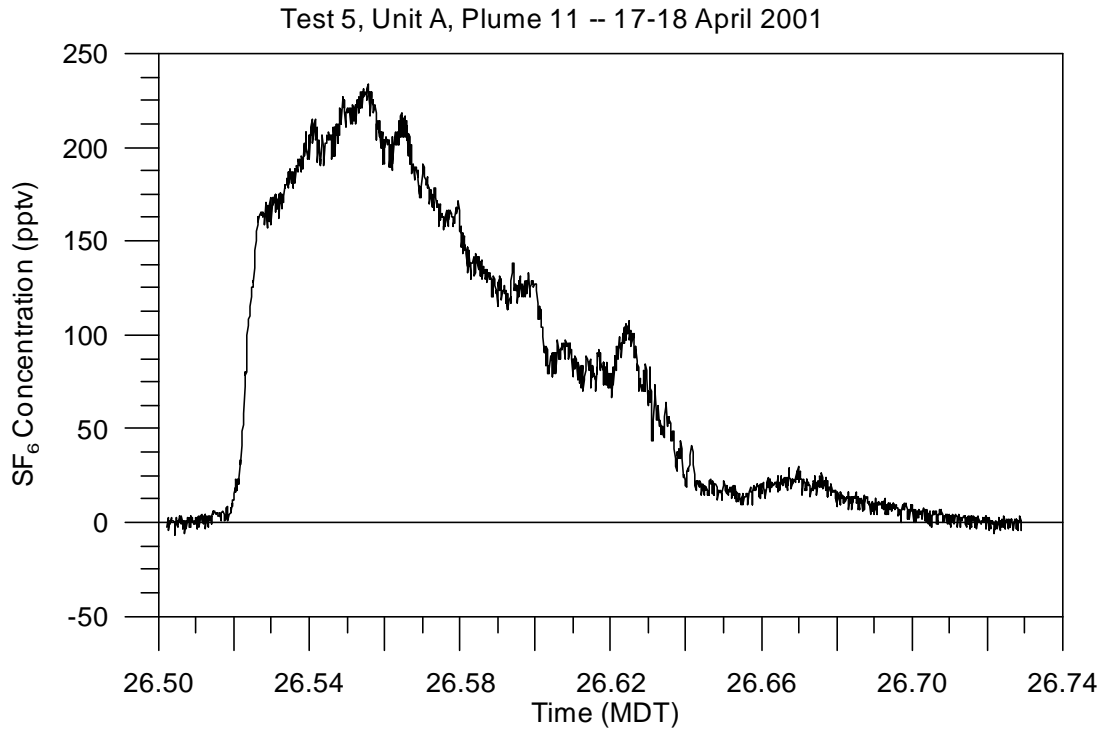


Figure A-174. SF₆ concentration of Plume 11 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

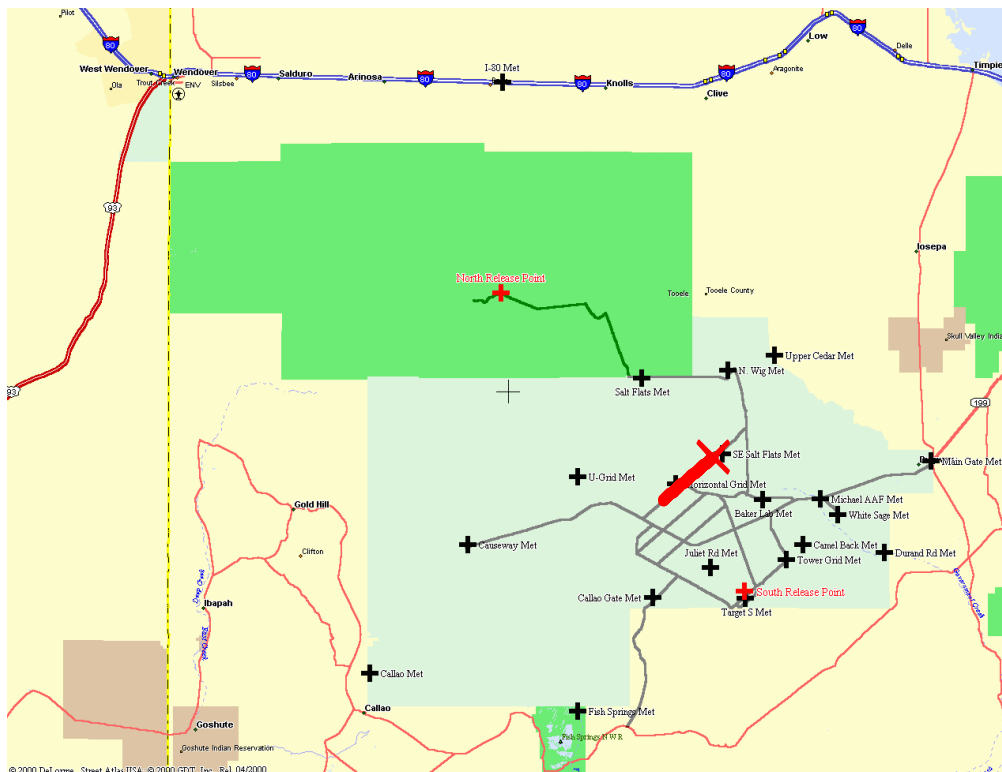
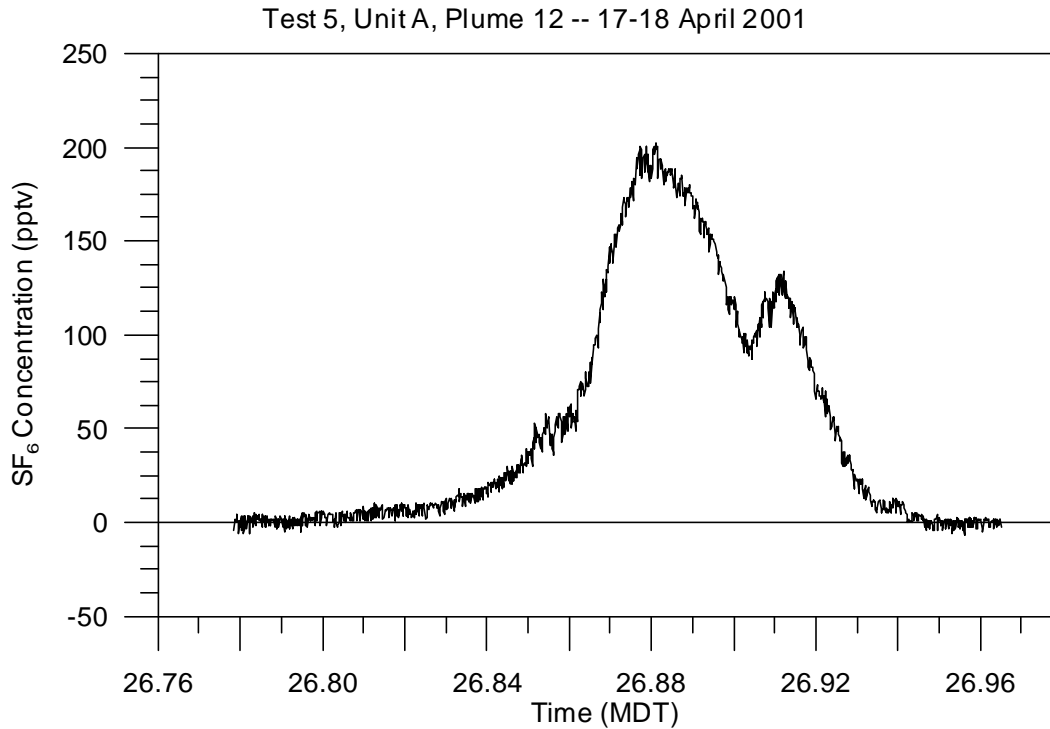


Figure A-175. SF₆ concentration of Plume 12 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

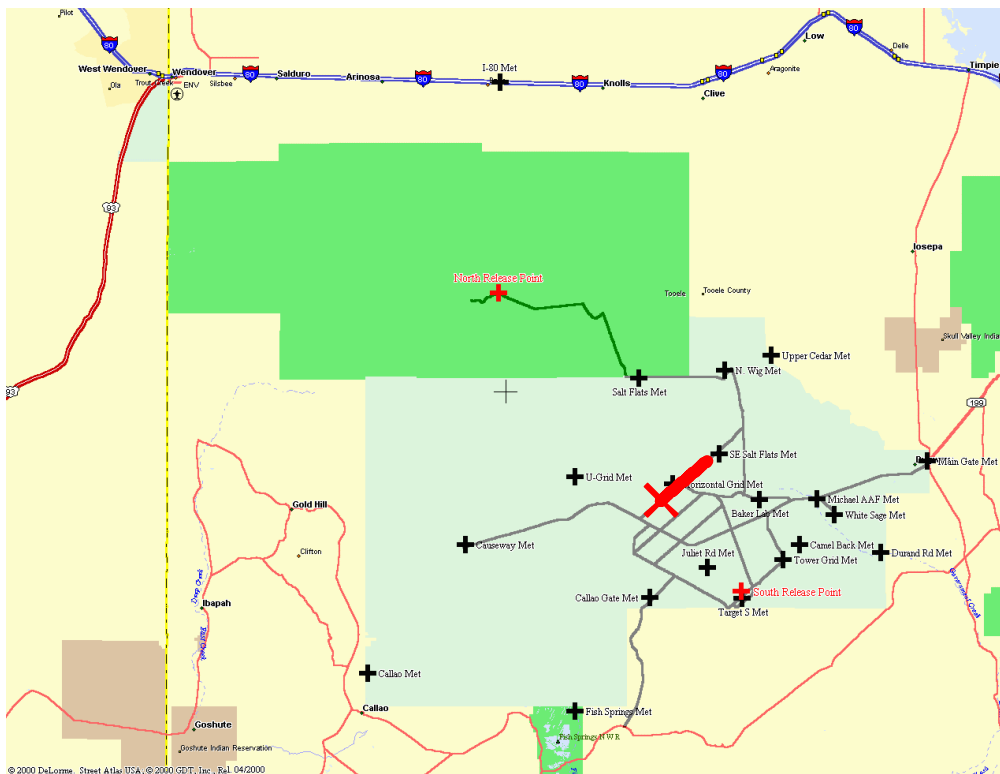
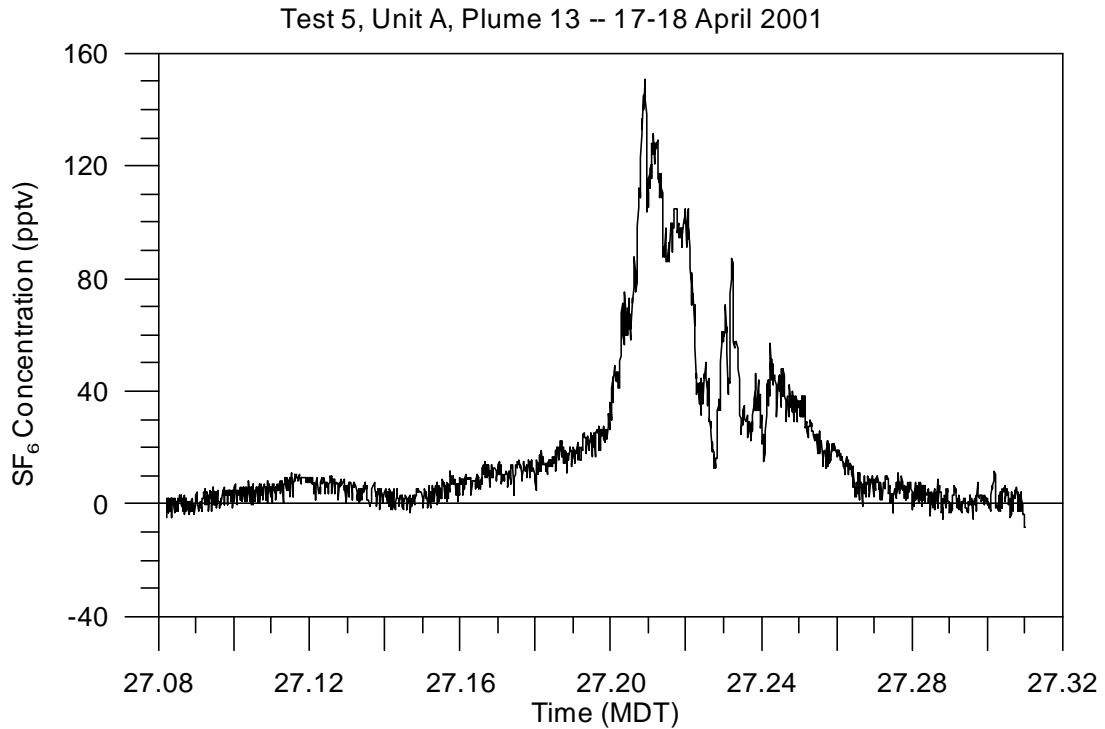


Figure A-176. SF₆ concentration of Plume 13 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

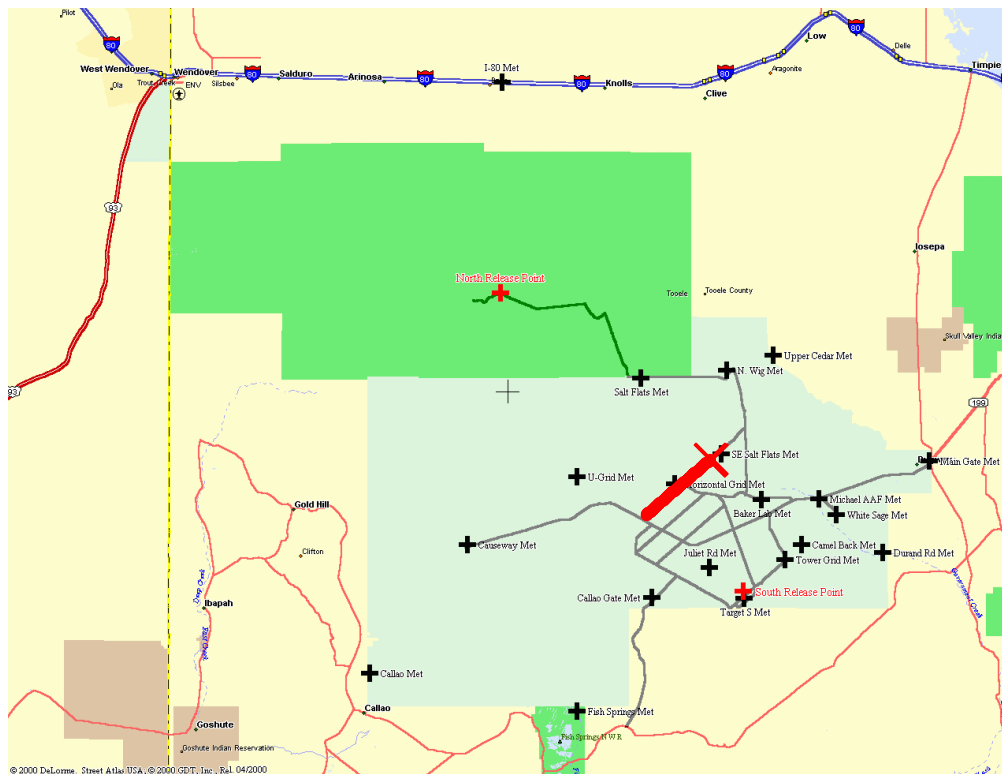
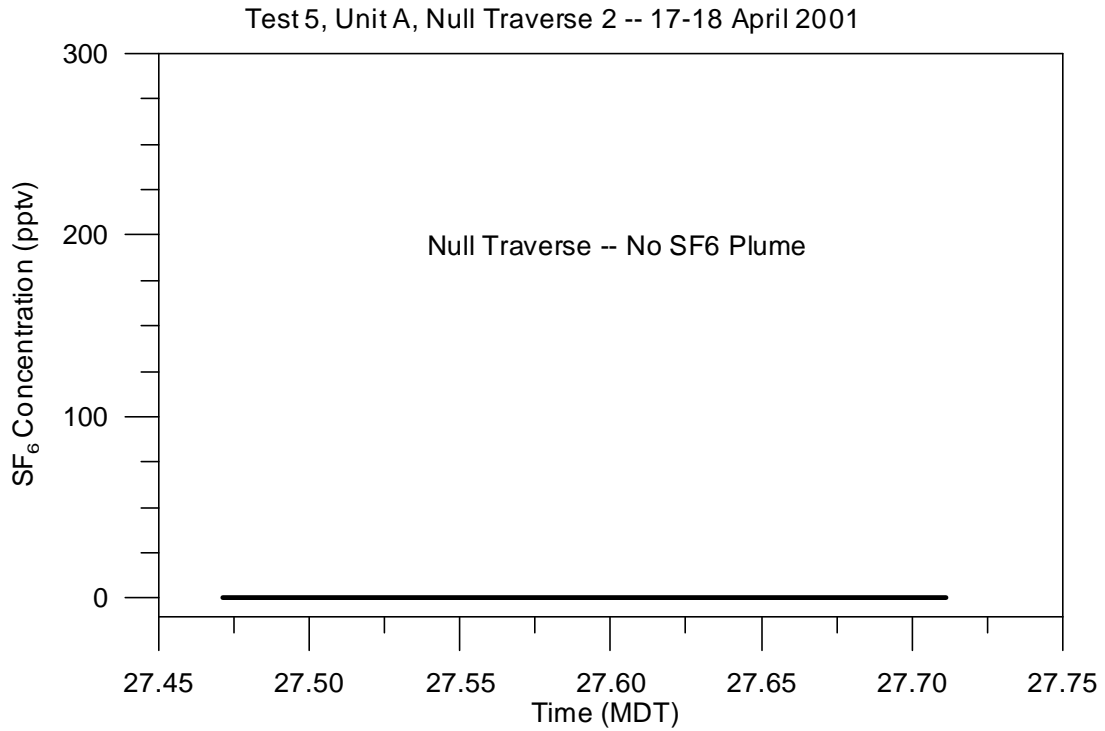


Figure A-177. Null sampling traverse 2 made by Sampling Unit A during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

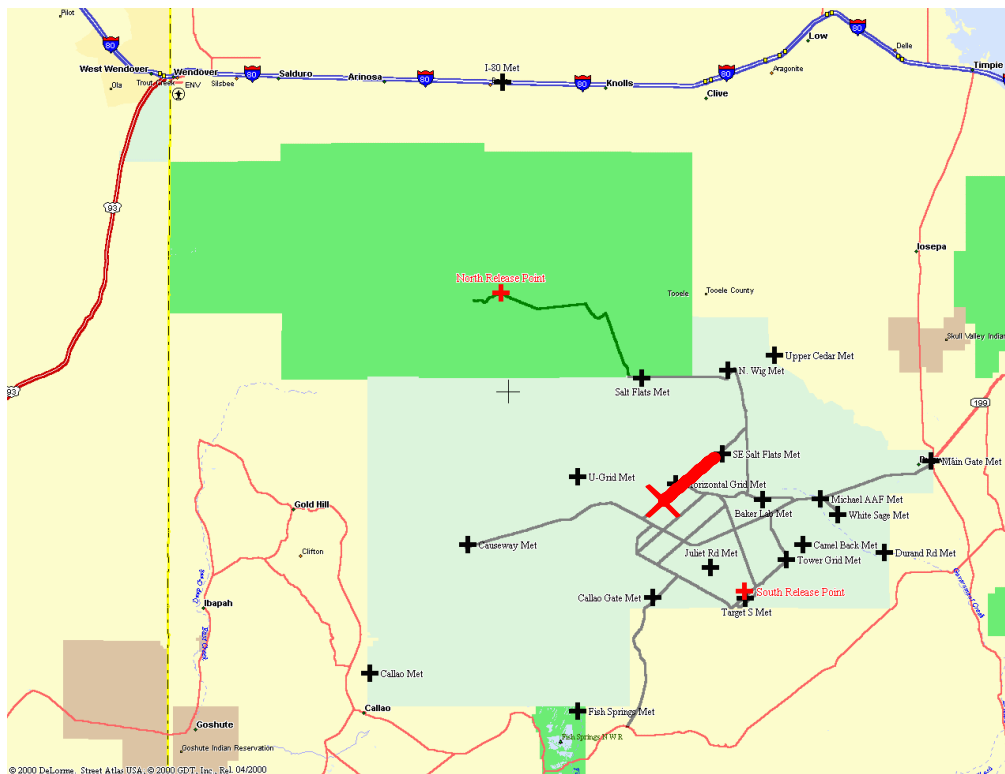
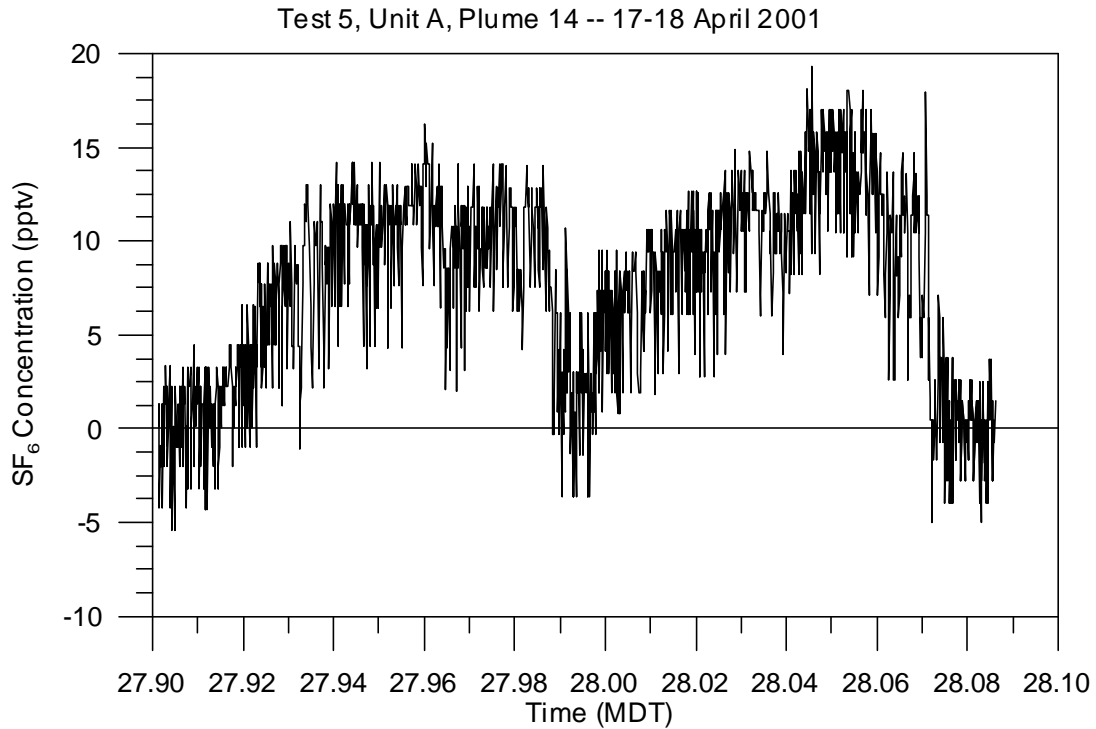


Figure A-178. SF₆ concentration of Plume 14 for Sampling Unit A during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 5 Sampling Unit B

Table A-45. Test 5 Sampling Unit B sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	23:12	23:29
2	23:37	23:54

Table A-46. Summary of individual SF₆ plume characteristics measured by Sampling Unit B during Test 5. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time* (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	24:23-26:40	10950**	320.8-359.0	31.21	37.63	56.00
2	26:51-27:47	6773	320.8-334.0	34.92	44.12	55.98

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

**Large number of data points mandated using every other data point in this analysis.

Table A-47. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit B during Test 5.

Plume Number	Concentration (pptv)	Time* (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	303.6**	24:42	40.330688	113.270097	328.3	35.51
2	108.0	27:12	40.437268	113.325418	330.9	48.10

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

**Large number of data points mandated using every other data point in this analysis.

Table A-48. Test 5 Sampling Unit B sampling traverses yielding no detectable SF₆ (null pass) after active SF₆ plume encounters.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
3	27:54	28:23
4	28:37	29:24

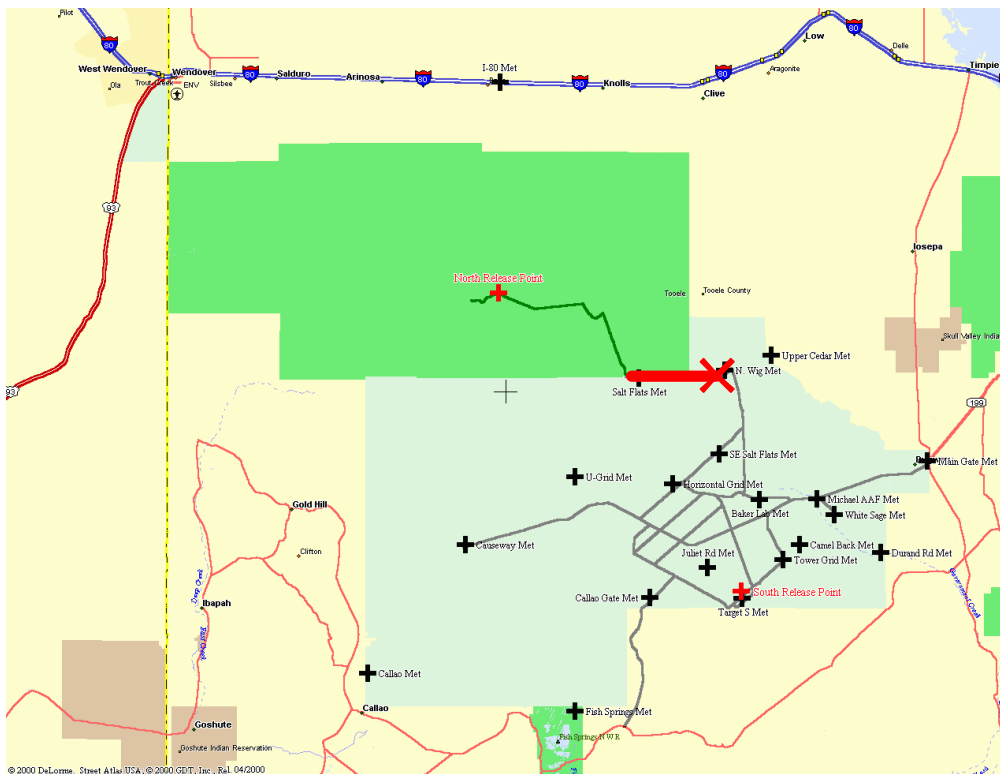
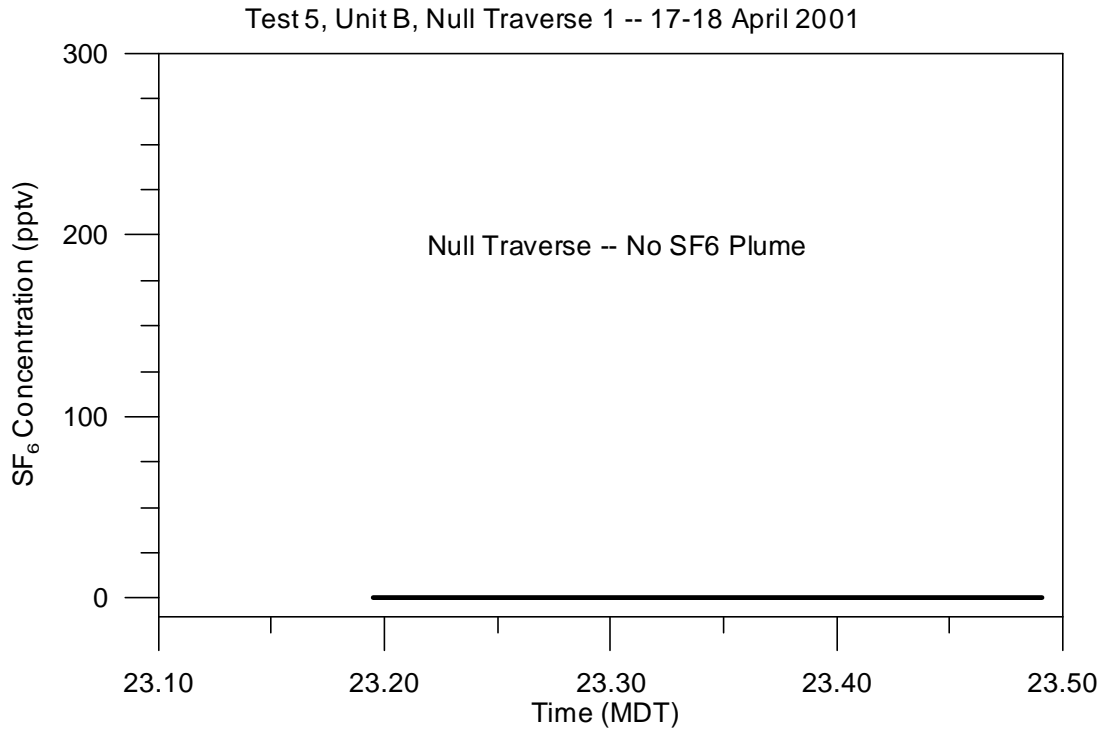


Figure A-179. Null sampling traverse 1 made by Sampling Unit B during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

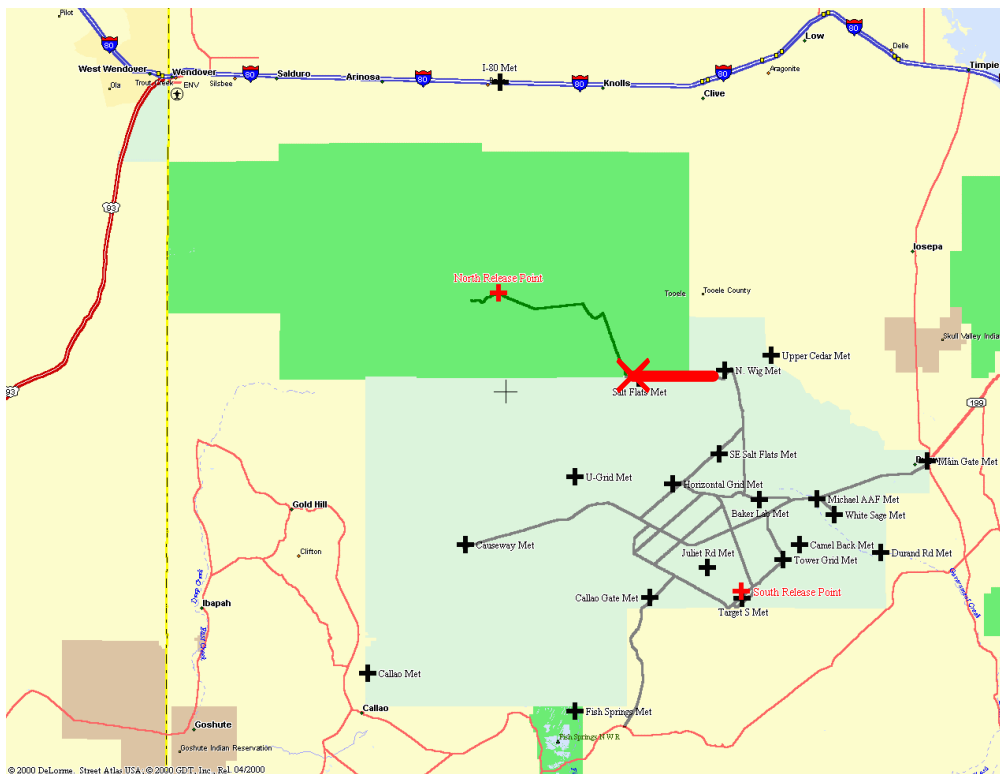
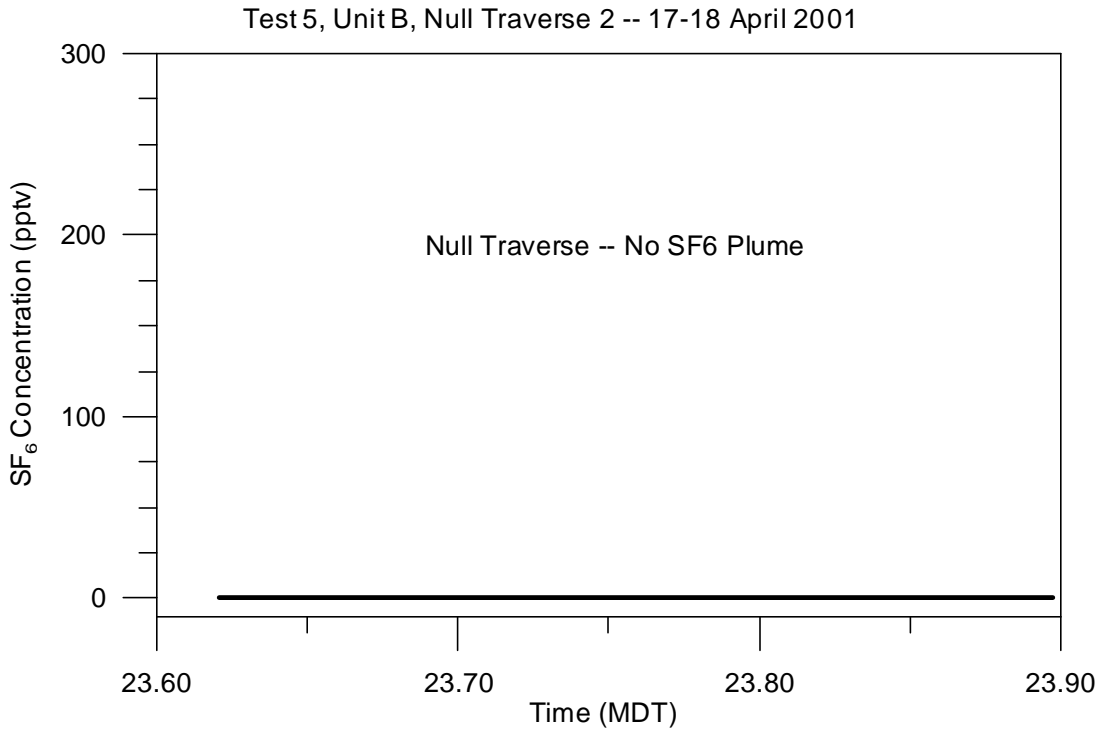


Figure A-180. Null sampling traverse 2 made by Sampling Unit B during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

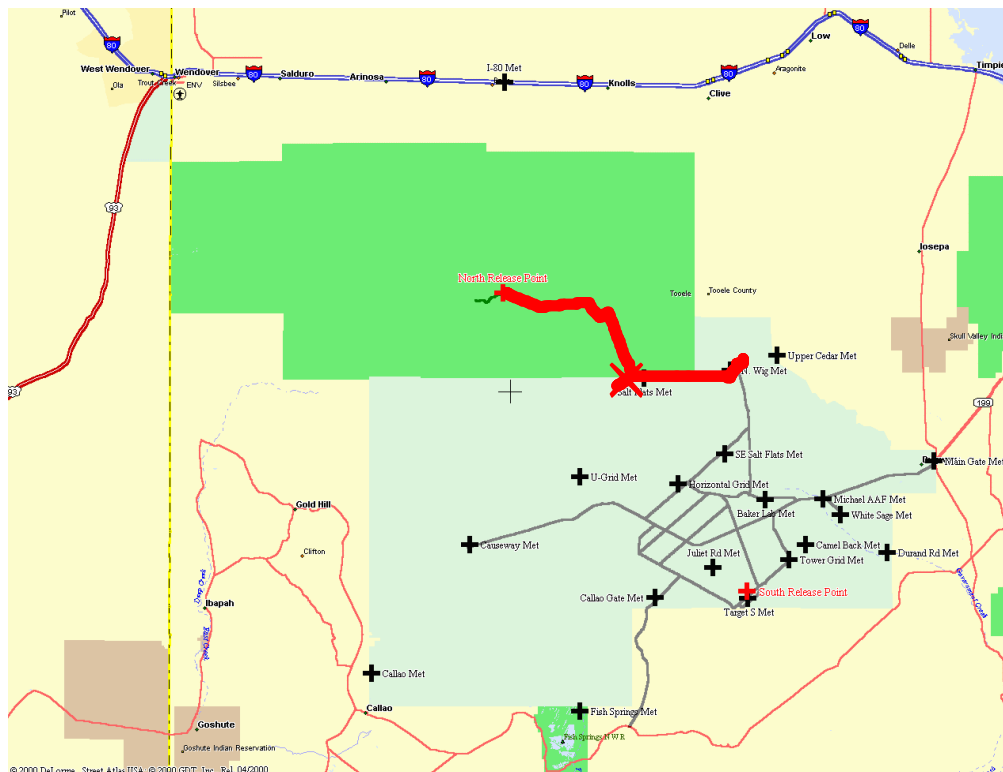
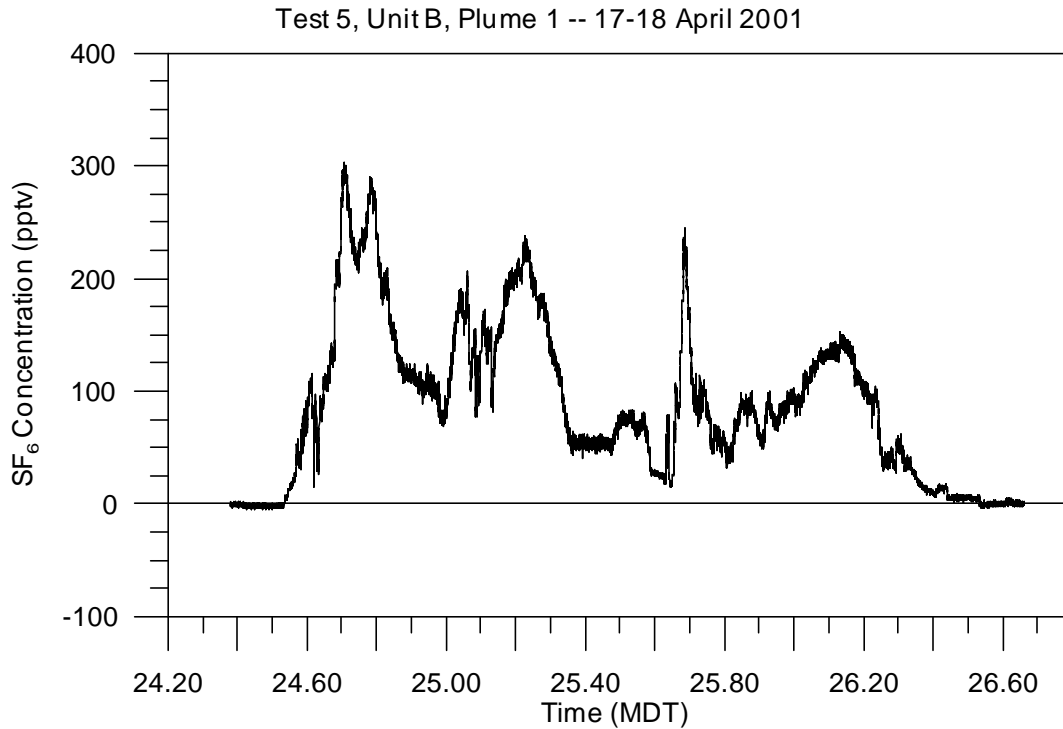


Figure A-181. SF₆ concentration of Plume 1 for Sampling Unit B during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

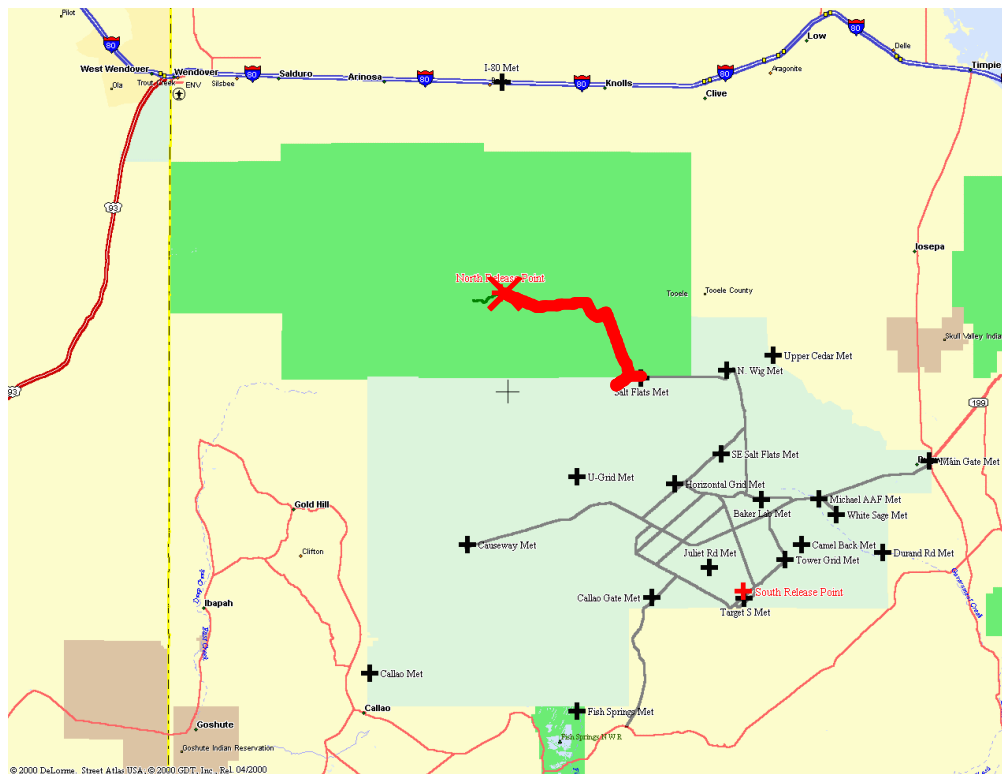
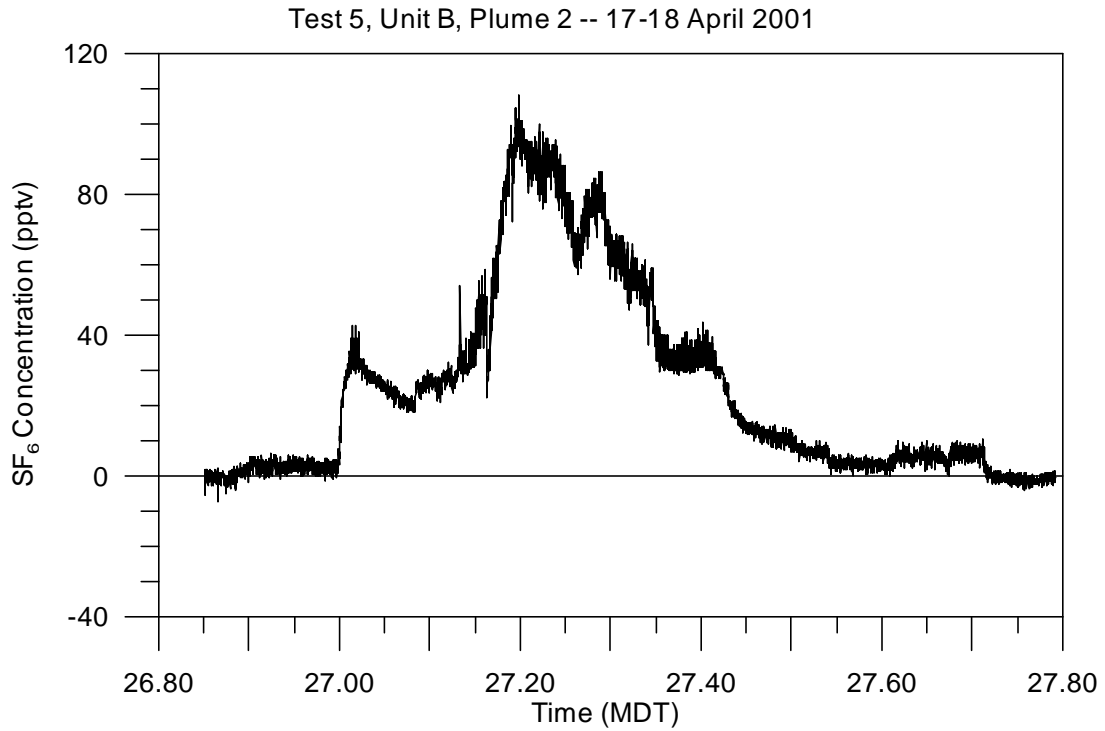


Figure A-182. SF₆ concentration of Plume 2 for Sampling Unit B during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

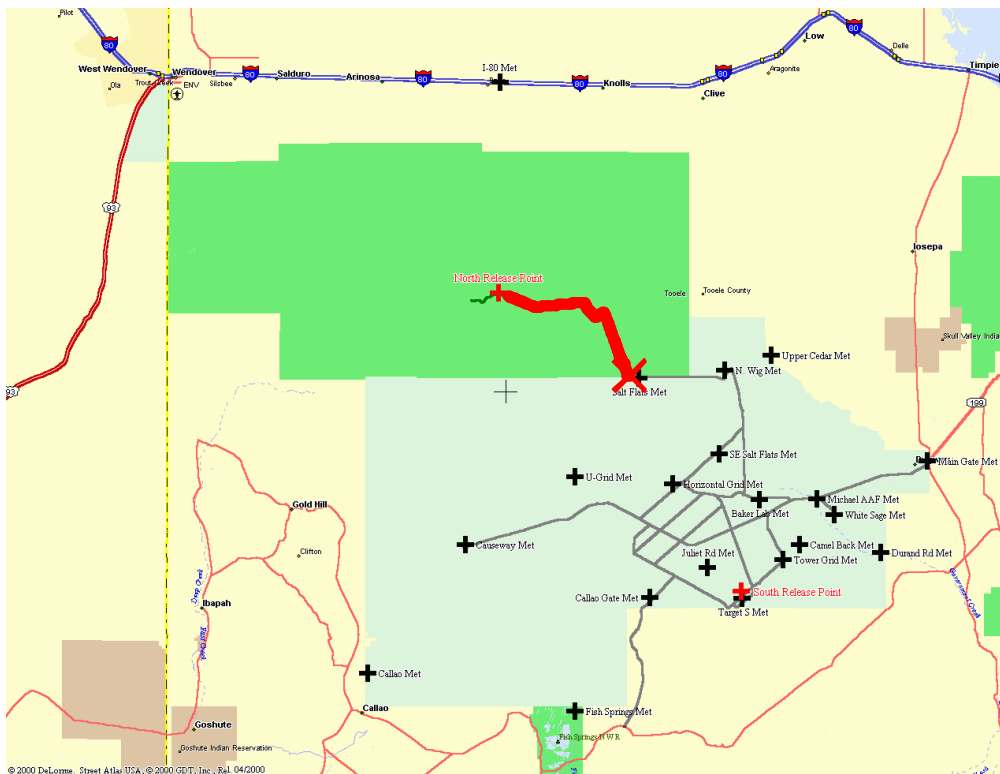
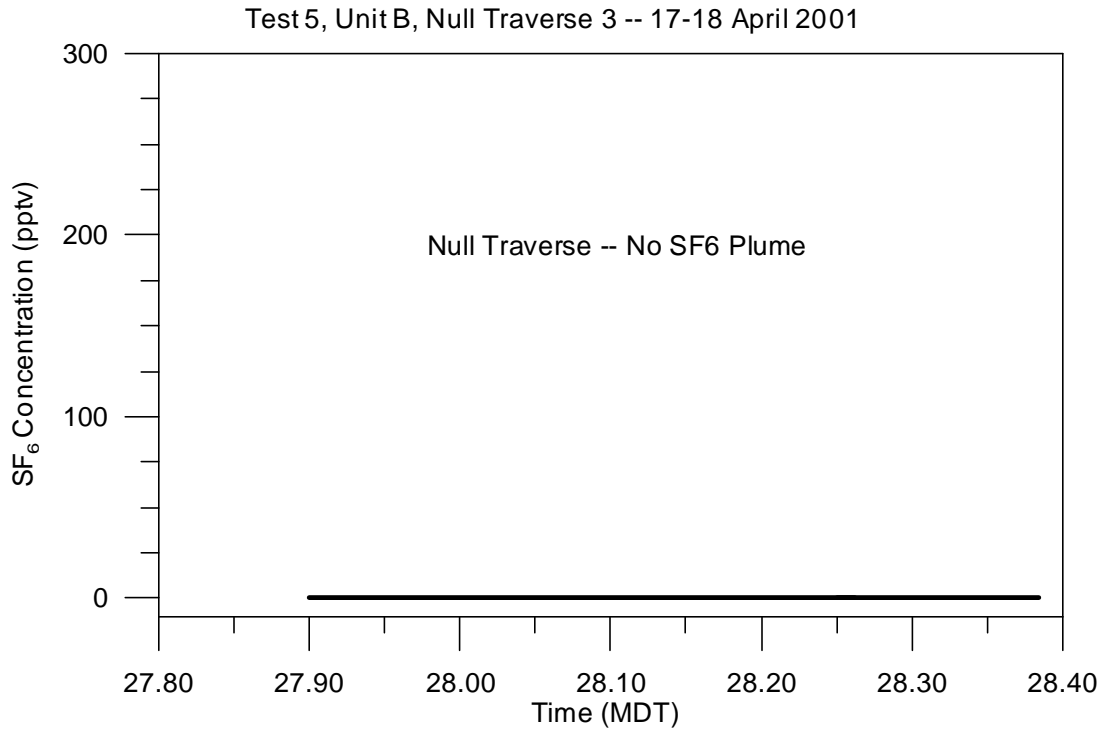


Figure A-183. Null sampling traverse 3 made by Sampling Unit B during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

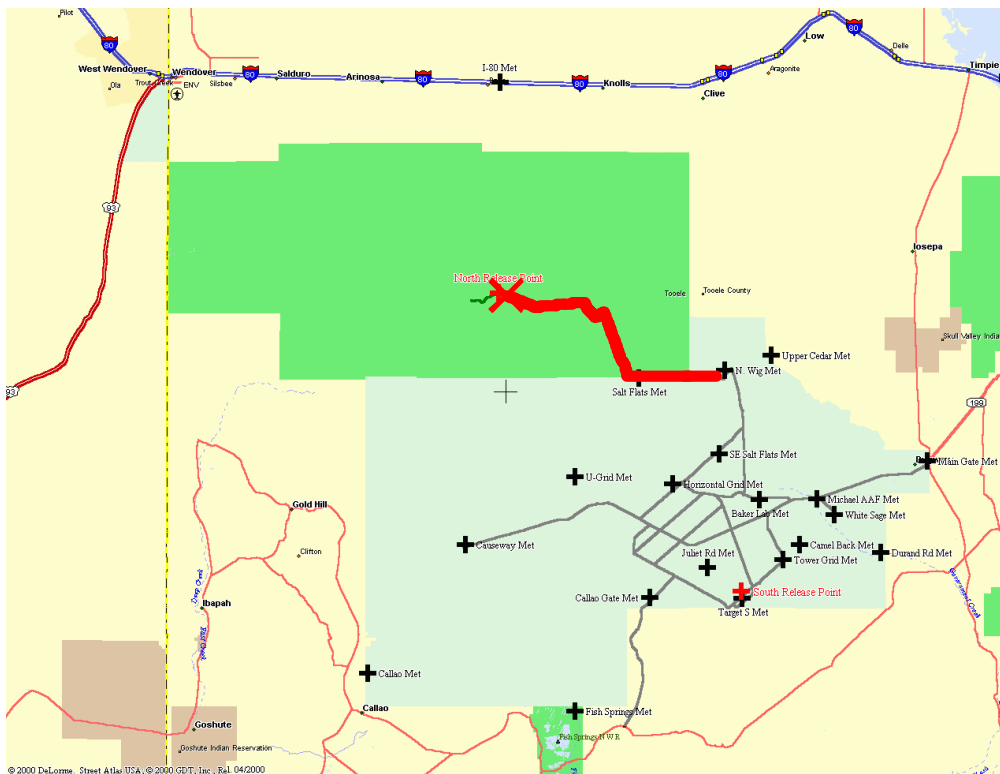
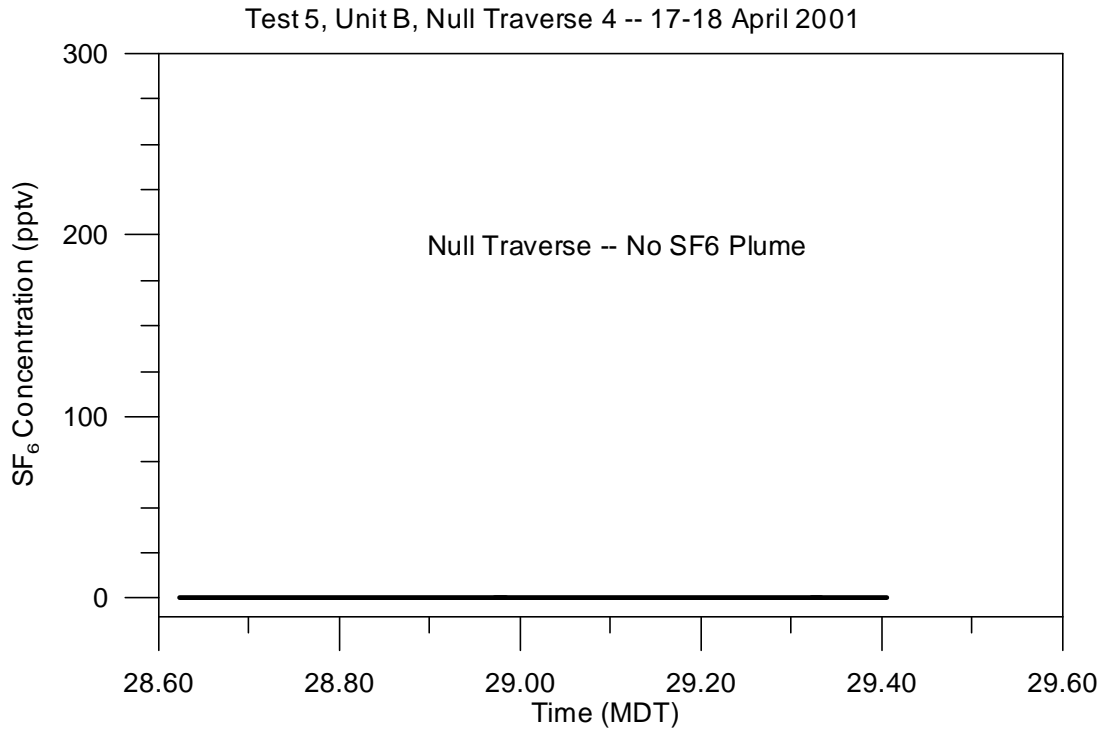


Figure A-184. Null sampling traverse 4 made by Sampling Unit B during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 5 Sampling Unit C

Table A-49. Test 5 Sampling Unit C sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	23:24	24:17
2	24:31	24:51
3	24:57	25:17
4	25:34	25:51
5	25:56	26:16

Table A-50. Summary of individual SF₆ plume characteristics measured by Sampling Unit C during Test 5. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time* (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	27:13-27:25	1461	342.4-356.7	74.48	75.76	78.01
2	27:43-27:57	1661	340.6-356.8	74.39	75.96	78.74
3	27:56-28:06	1235	356.2-6.4	75.00	78.07	82.88
4	28:29-28:44	1821	339.5-356.8	74.48	76.29	79.46
5	28:49-29:08	2307	338.3-0.4	74.38	76.36	80.01
6	29:25-29:39	1661	344.8-1.1	74.49	75.62	77.24
7	29:42-29:55	1561	344.2-359.6	74.38	75.45	77.11
8	30:05-30:15	1121	348.9-359.9	74.48	75.24	76.68
9	30:19-30:23	441	337.6-342.9	77.79	79.11	80.57

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

Table A-51. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit C during Test 5.

Plume Number	Concentration (pptv)	Time* (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	146.3	27:18	40.726645	113.196690	350.5	75.18
2	145.3	27:49	40.726268	113.238785	347.8	75.82
3	29.7	28:01	40.758180	113.016522	2.2	77.71
4	111.2	28:37	40.727273	113.249823	347.1	76.13
5	90.2	28:57	40.726442	113.256858	346.7	76.18
6	95.1	29:35	40.726813	113.211267	349.6	75.42
7	69.2	29:50	40.725213	113.157855	353.0	74.55
8	58.0	30:08	40.734943	113.104725	356.5	75.21
9	13.6	30:21	40.728818	113.362620	340.3	78.99

*This test spanned two days. Time values greater than 24 indicate that the data are from the second day. To obtain the correct time during the second day, subtract 24 hours.

No null passes were made by Sampling Unit C either during or after the time period of active plume sampling listed in the previous two tables.

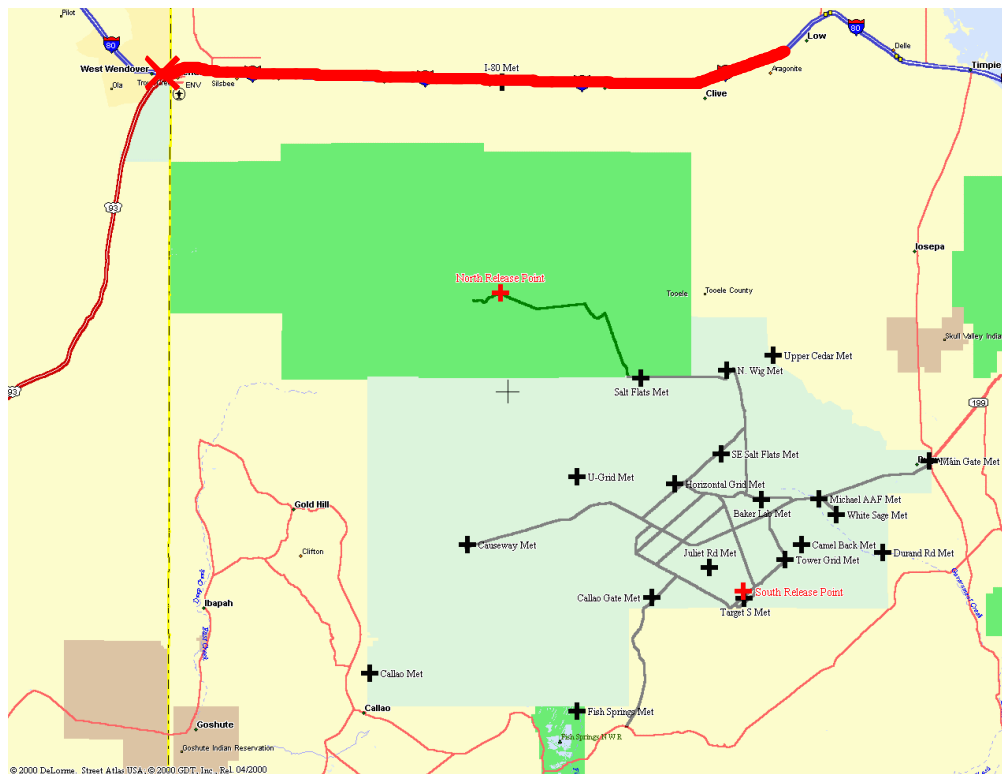
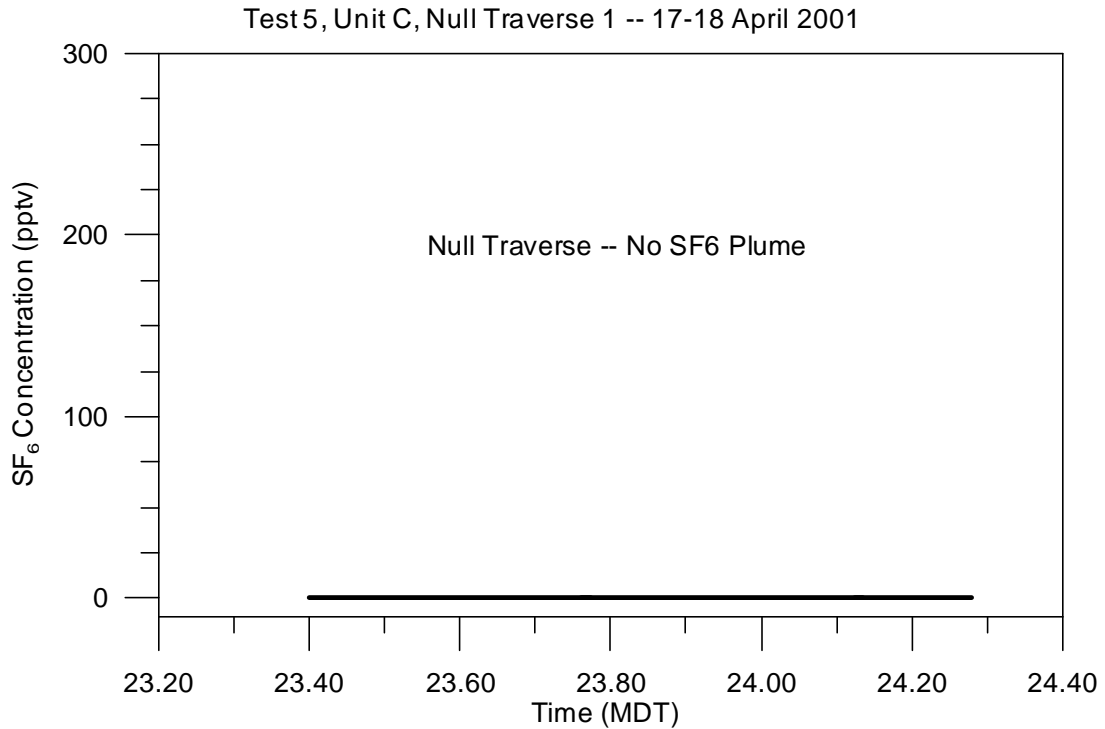


Figure A-185. Null sampling traverse 1 made by Sampling Unit C during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

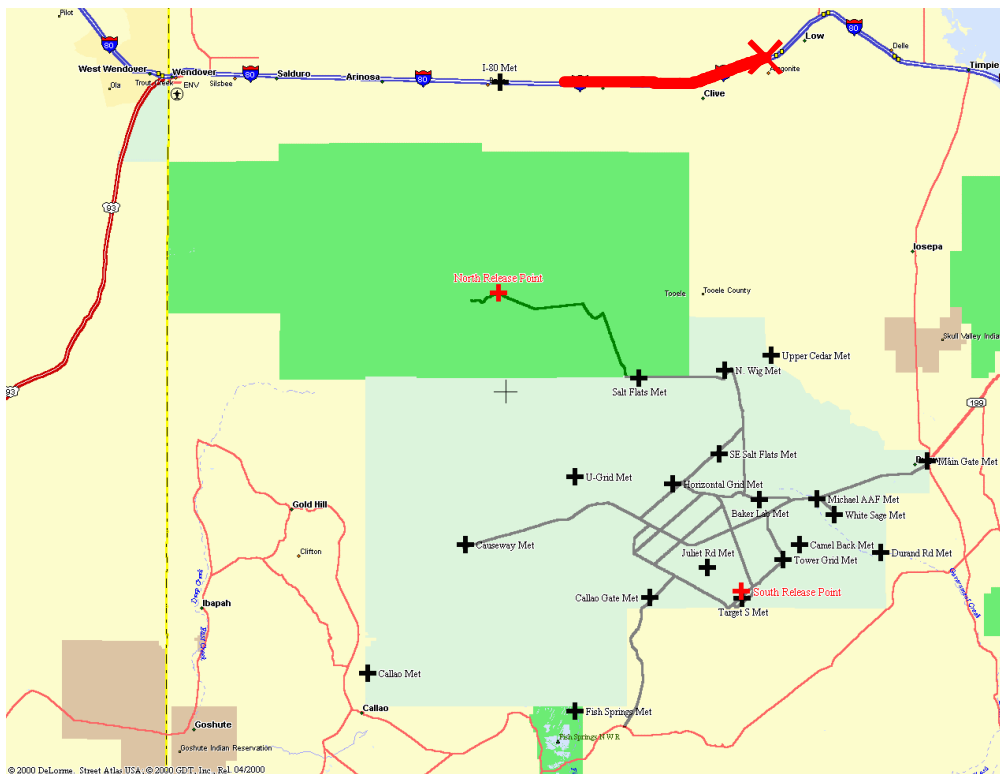
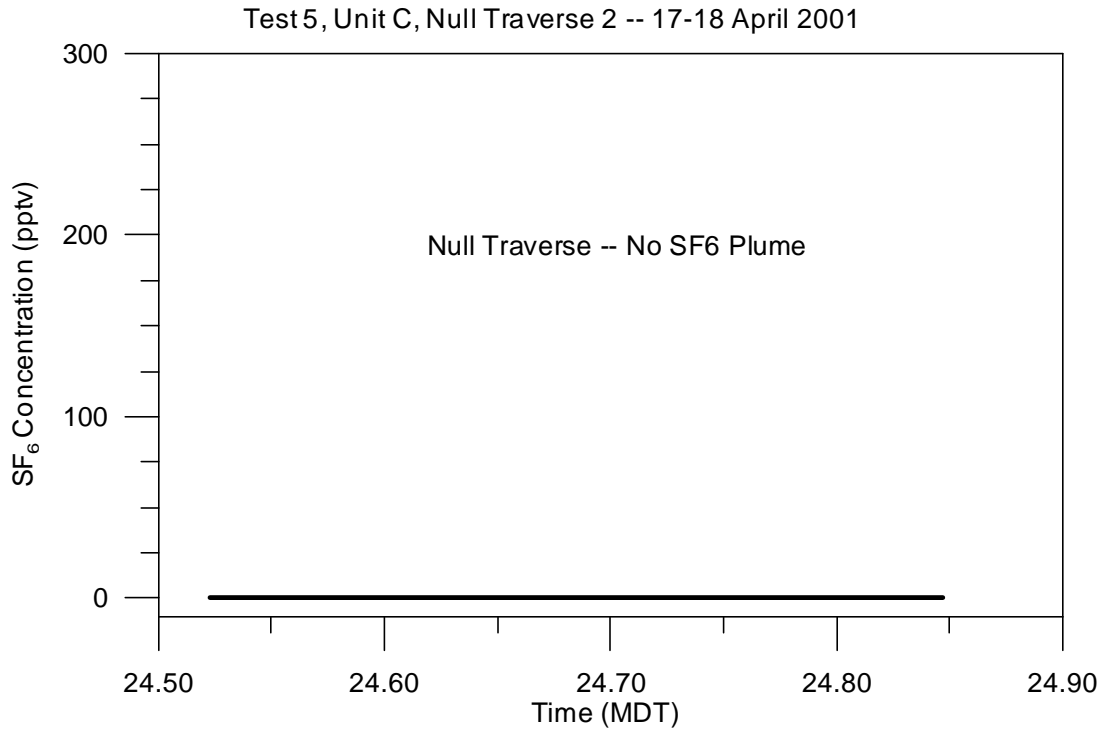


Figure A-186. Null sampling traverse 2 made by Sampling Unit C during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

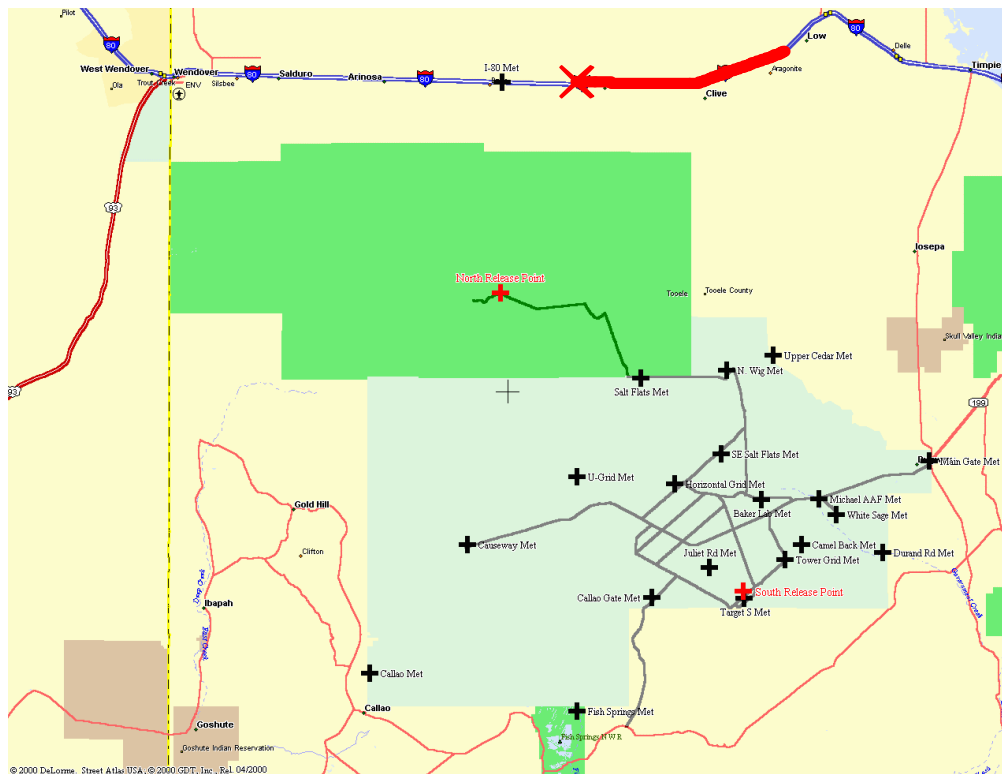
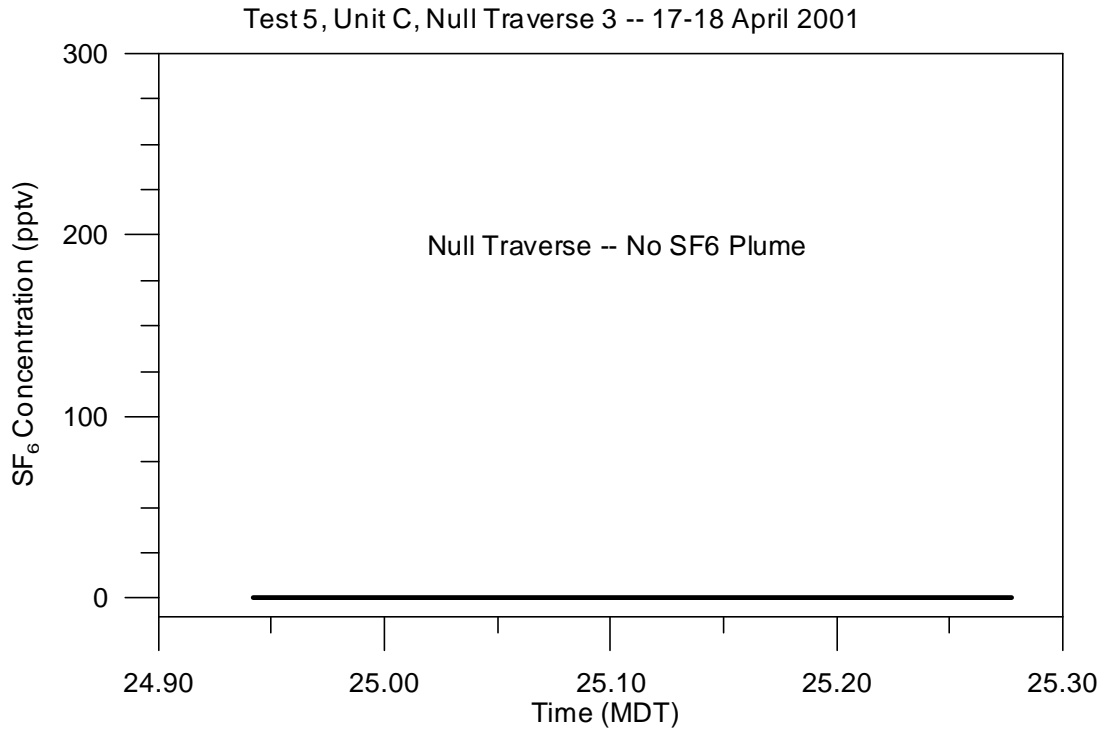


Figure A-187. Null sampling traverse 3 made by Sampling Unit C during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

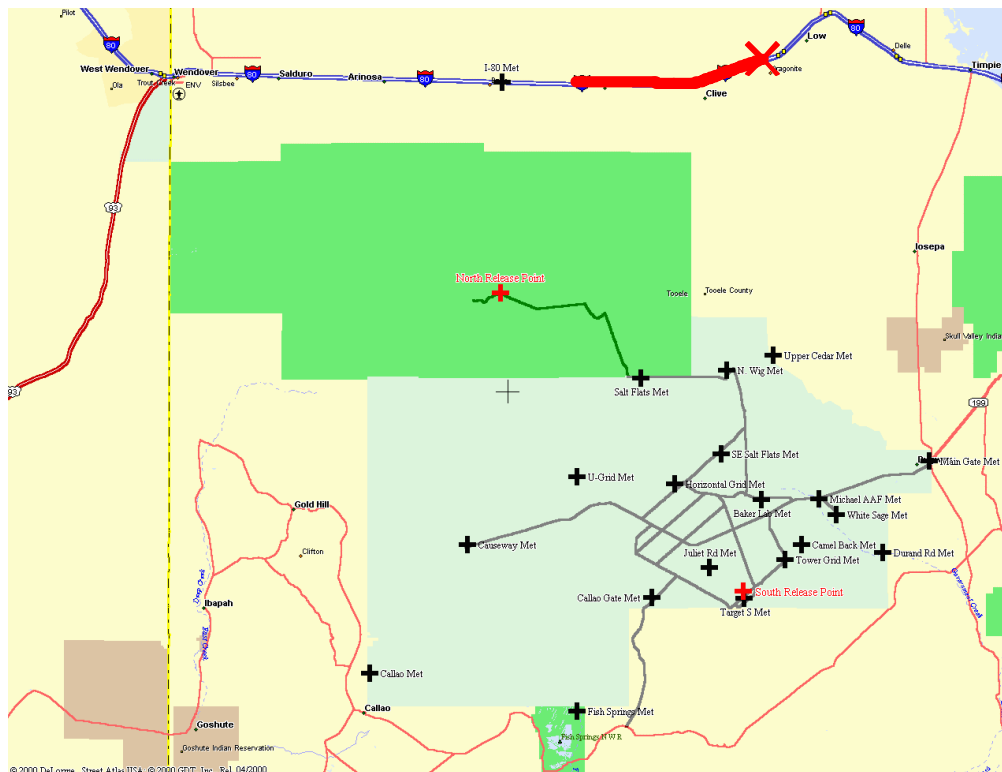
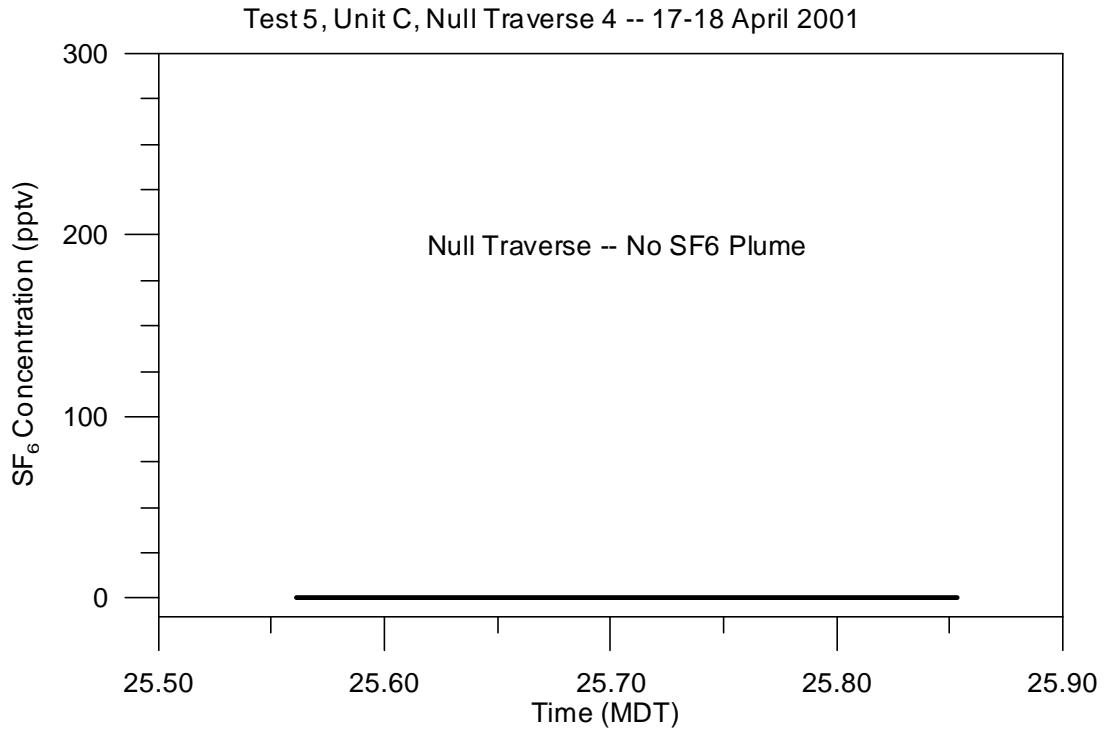


Figure A-188. Null sampling traverse 4 made by Sampling Unit C during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

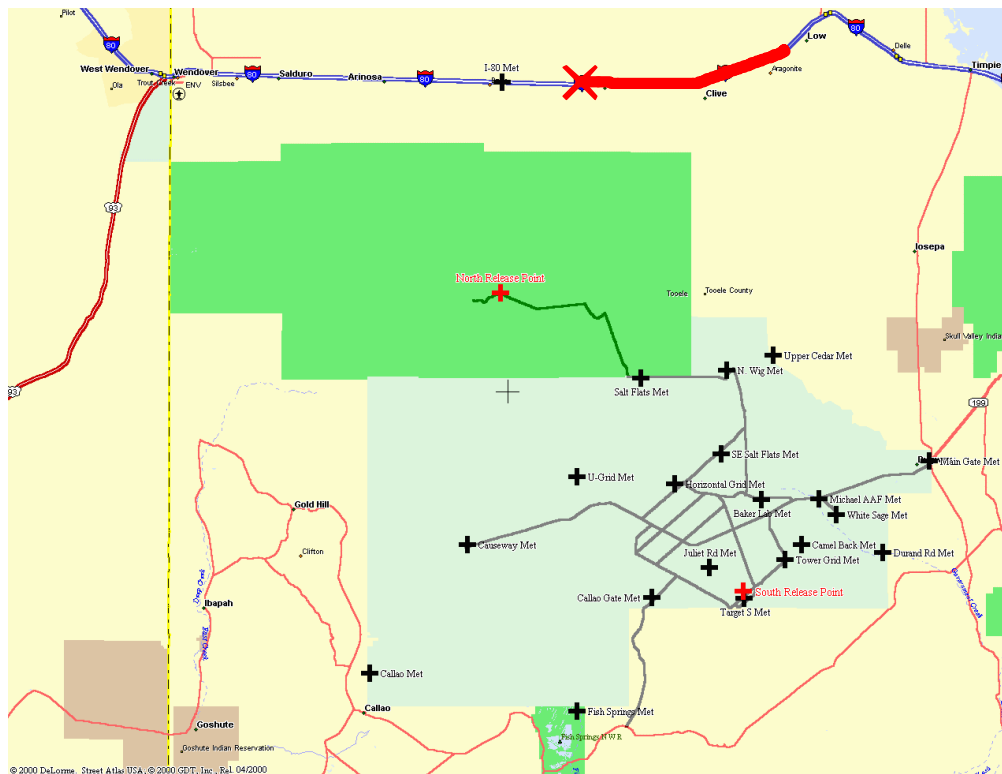
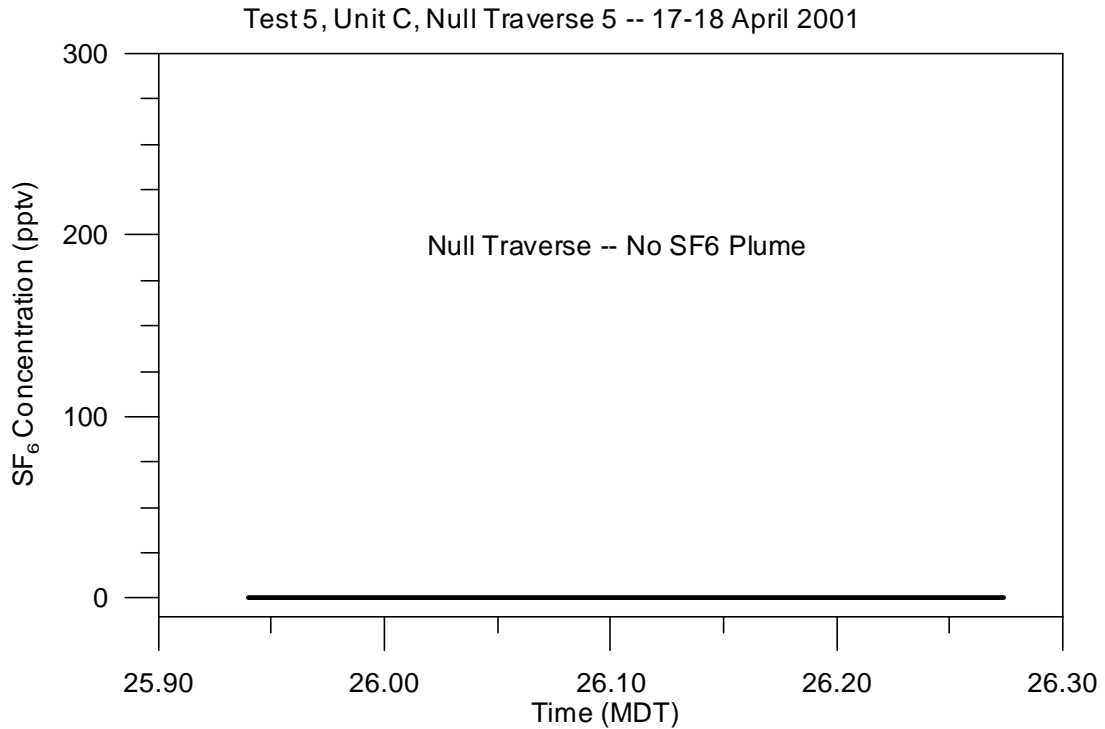


Figure A-189. Null sampling traverse 5 made by Sampling Unit C during Test 5, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

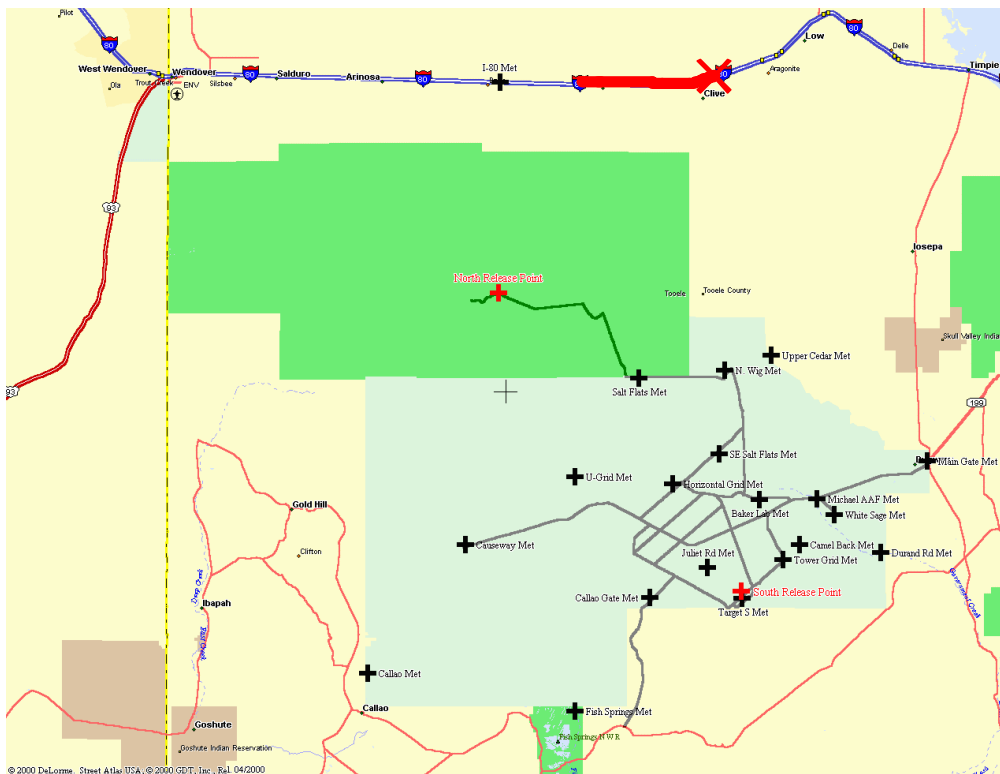
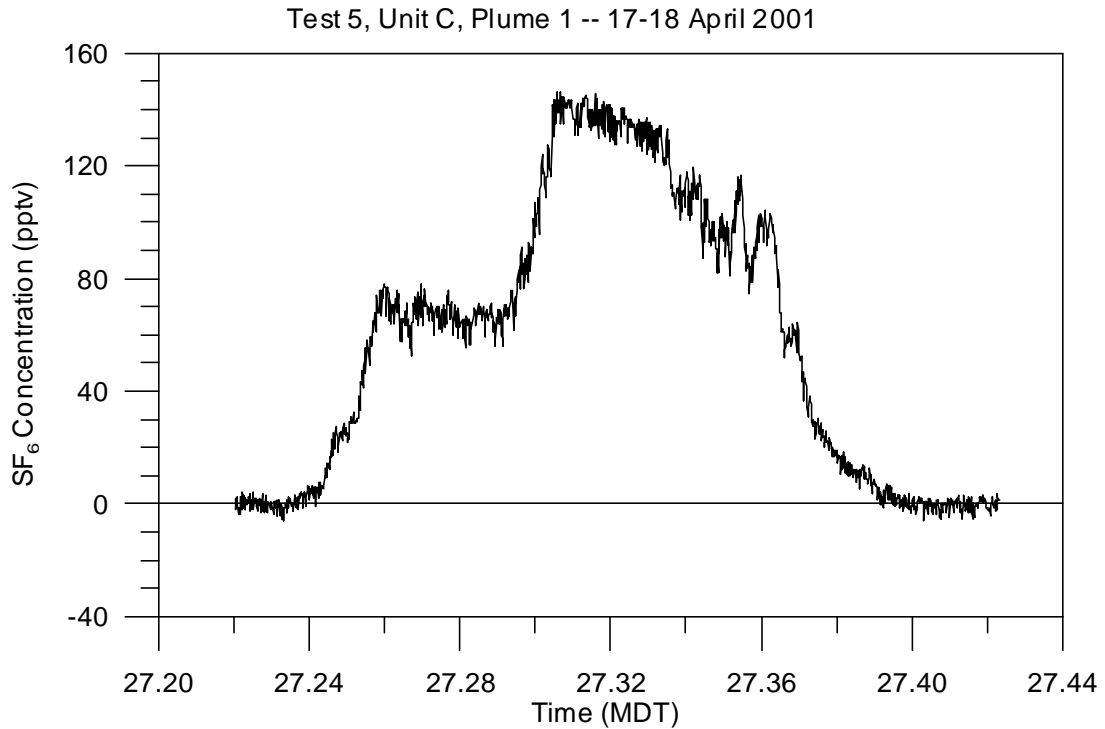


Figure A-190. SF₆ concentration of Plume 1 for Sampling Unit C during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

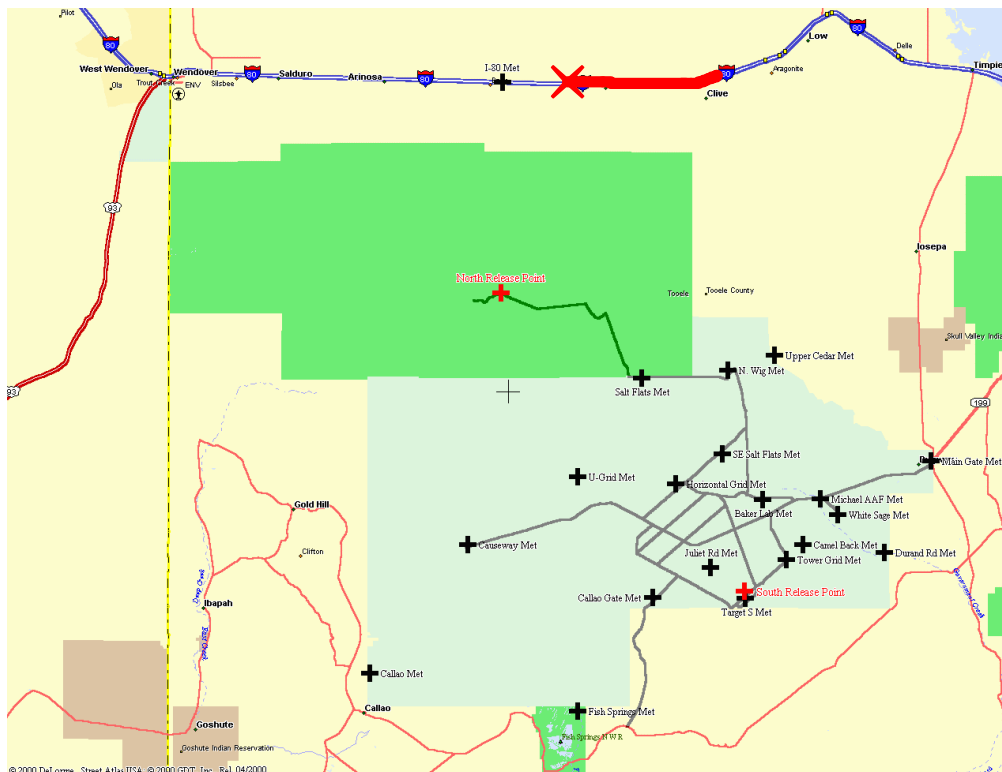
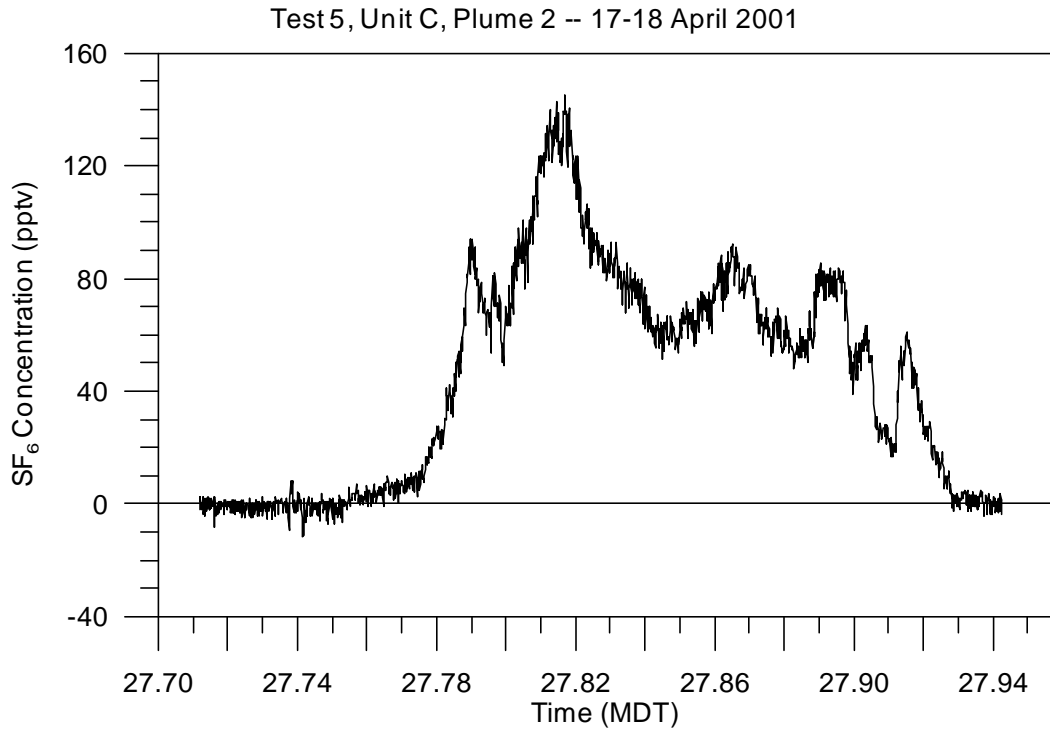


Figure A-191. SF₆ concentration of Plume 2 for Sampling Unit C during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

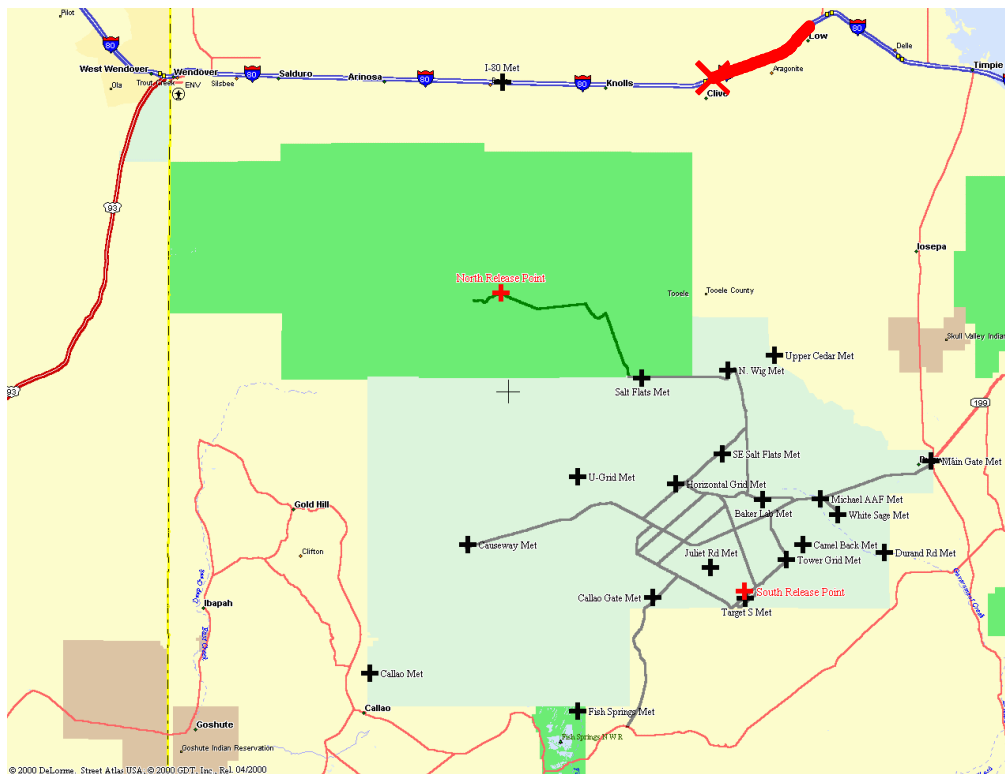
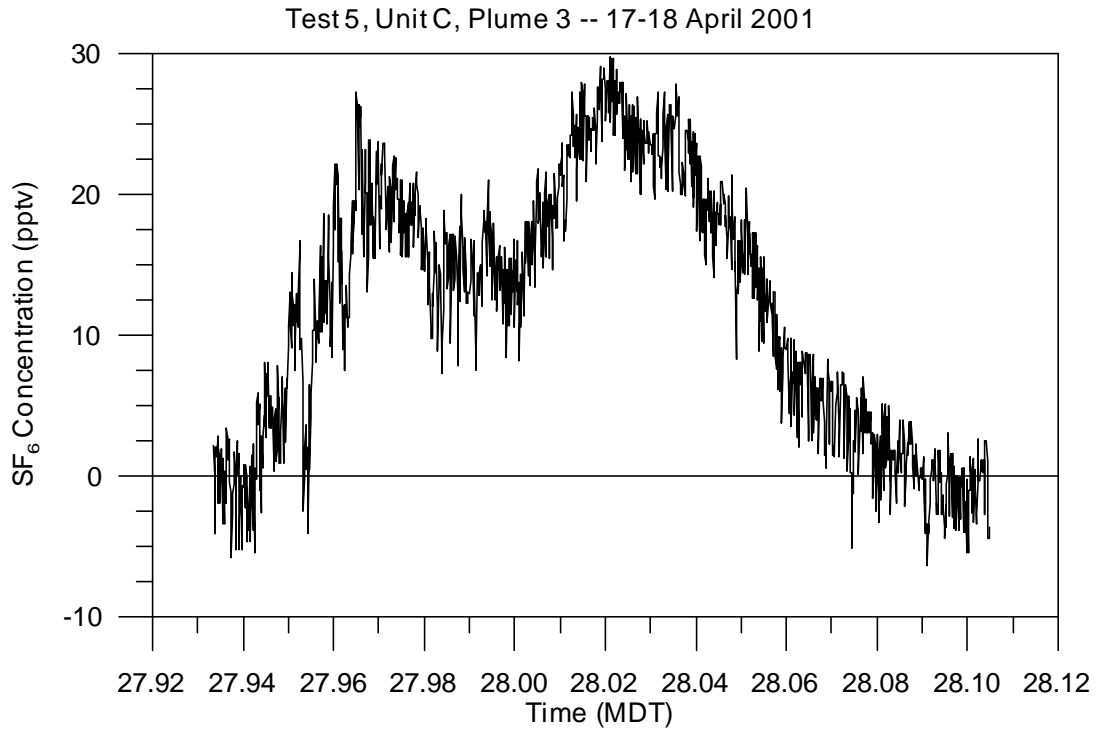


Figure A-192. SF₆ concentration of Plume 3 for Sampling Unit C during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

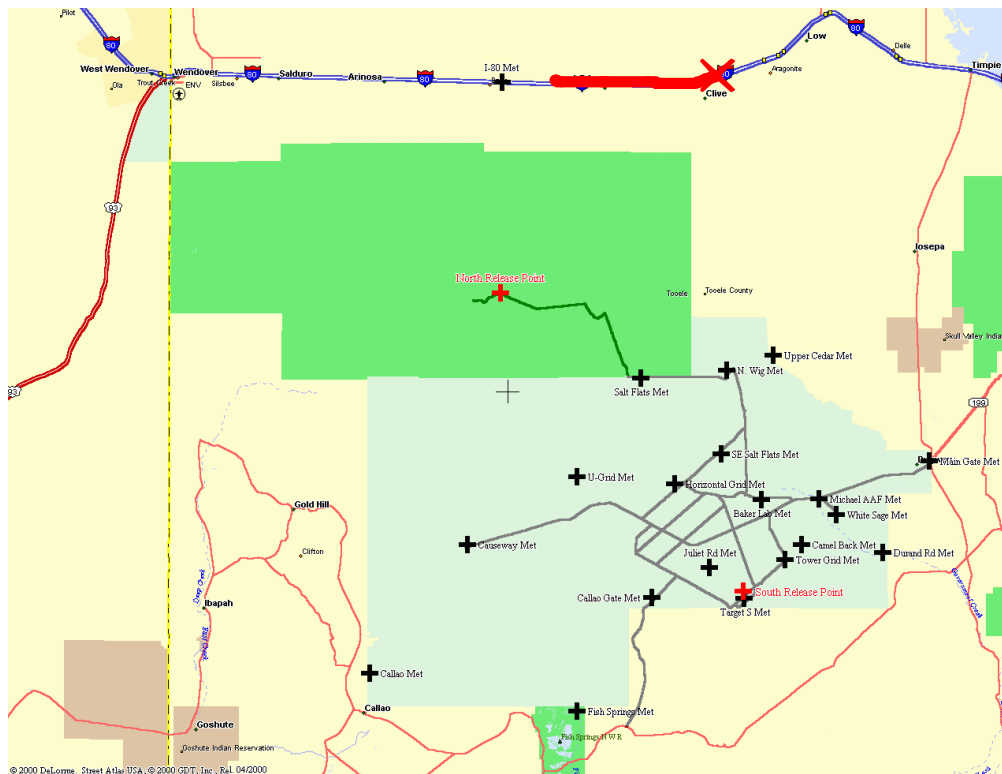
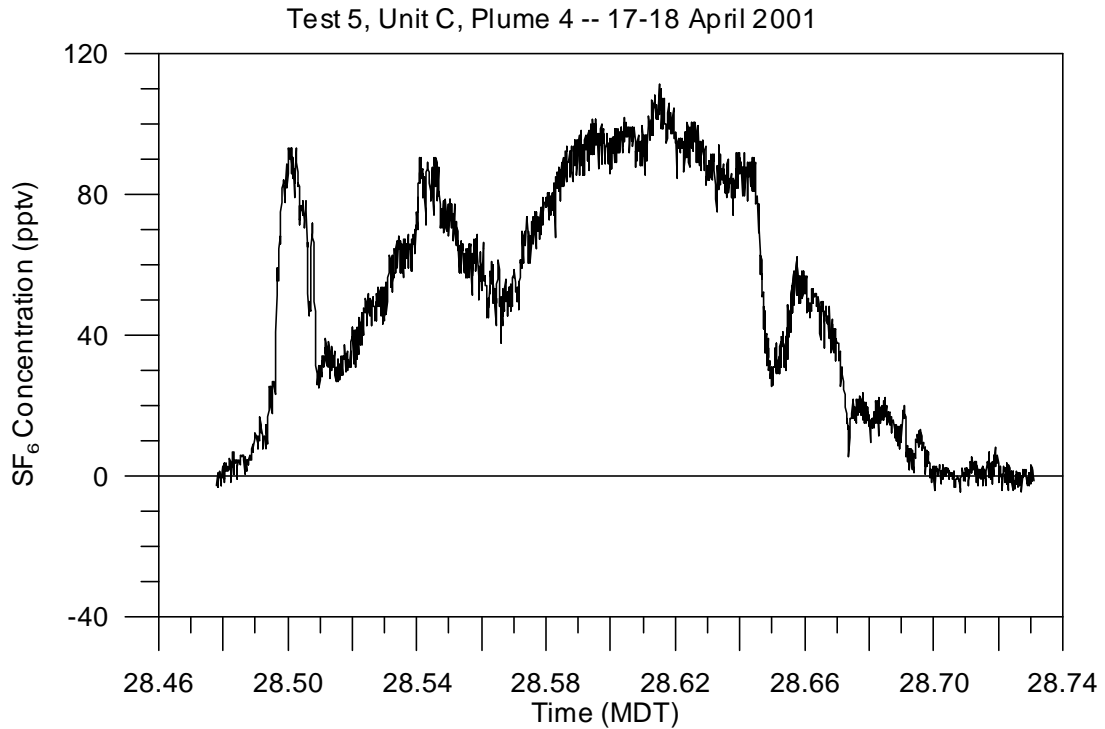


Figure A-193. SF₆ concentration of Plume 4 for Sampling Unit C during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

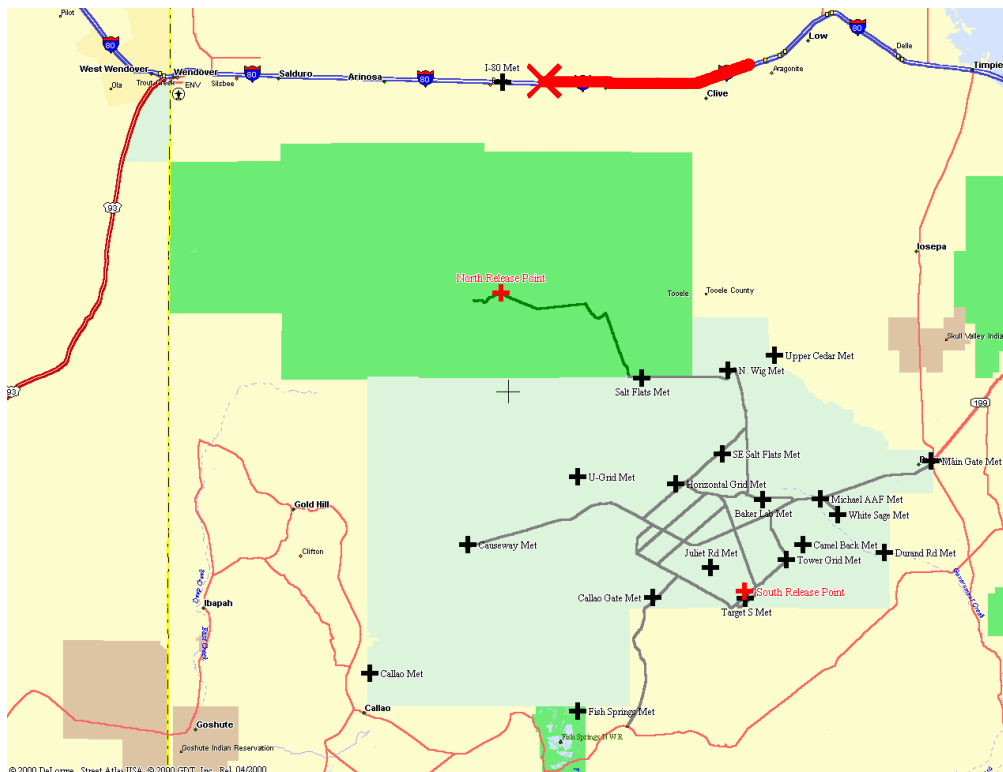
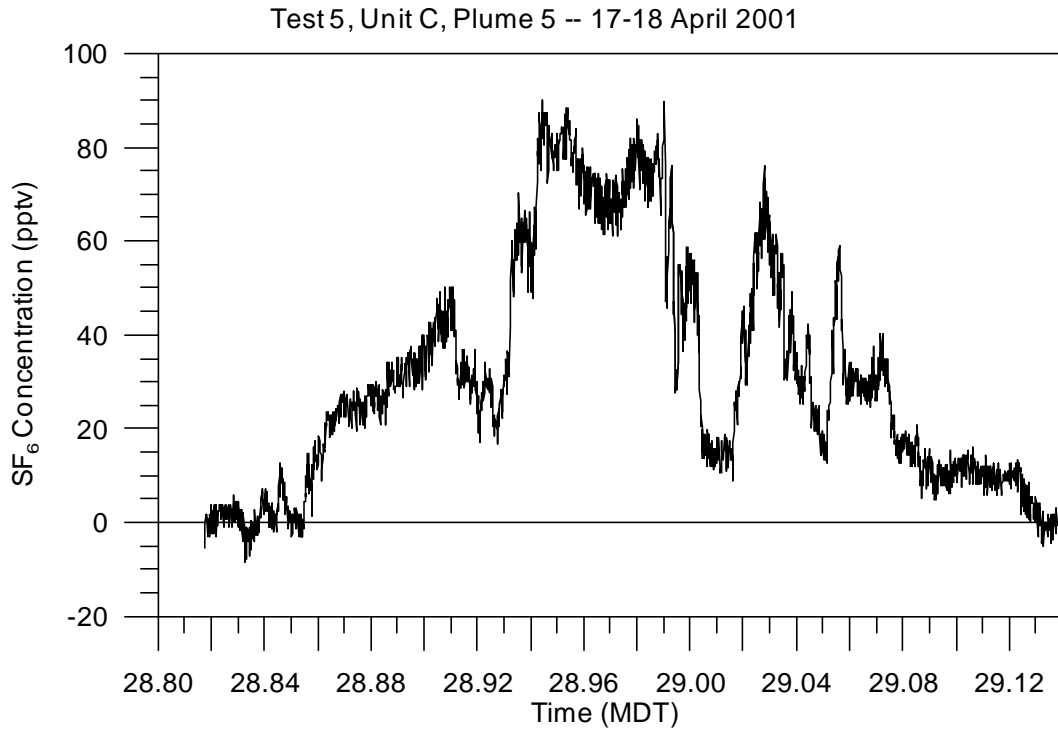


Figure A-194. SF₆ concentration of Plume 5 for Sampling Unit C during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

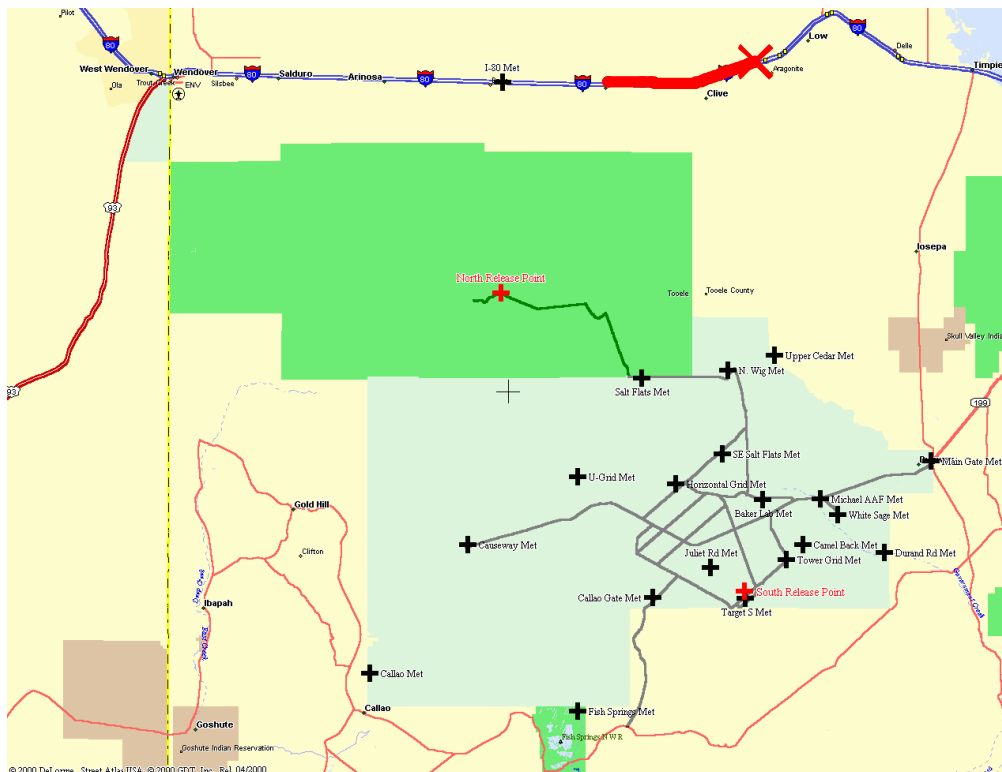
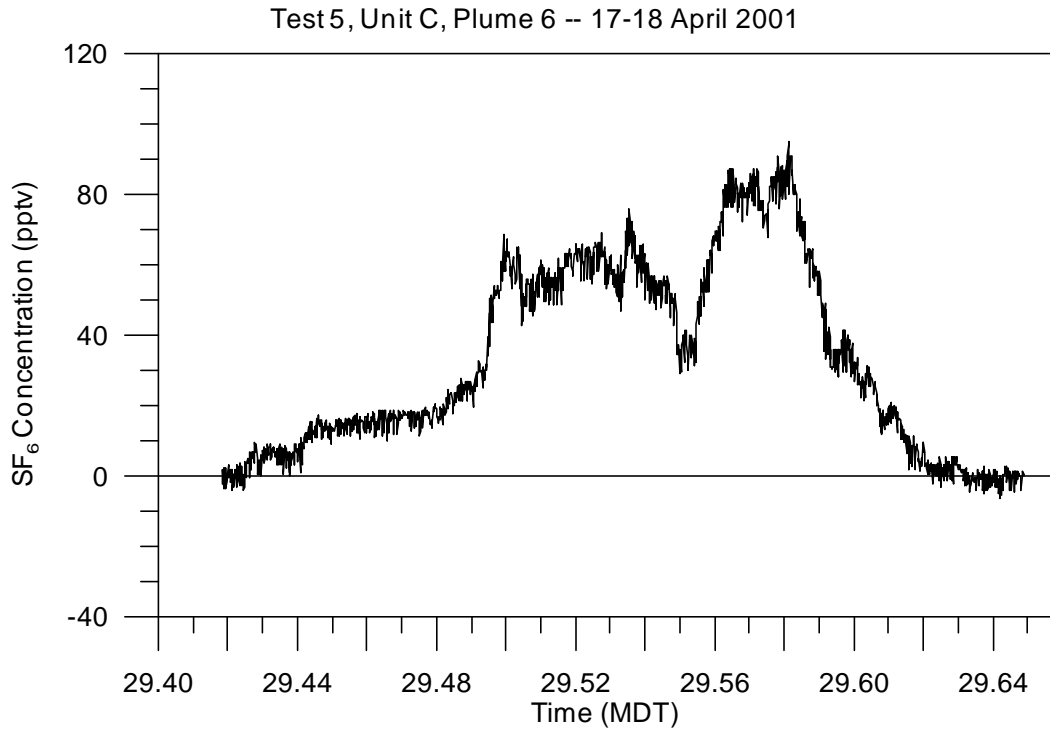


Figure A-195. SF₆ concentration of Plume 6 for Sampling Unit C during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

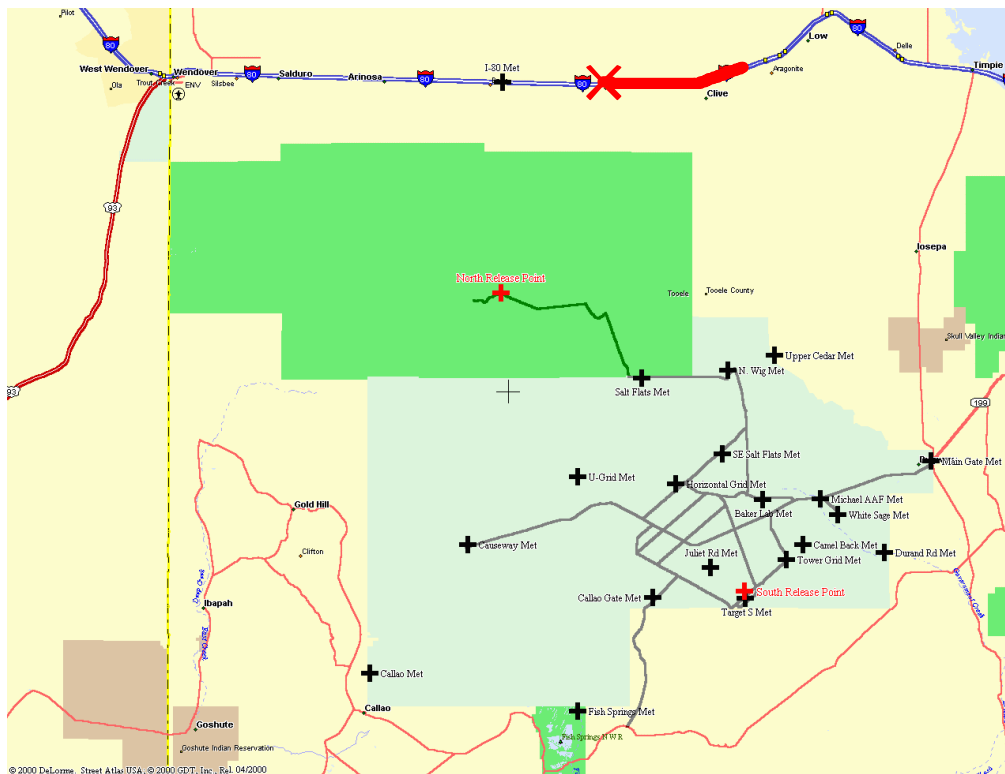
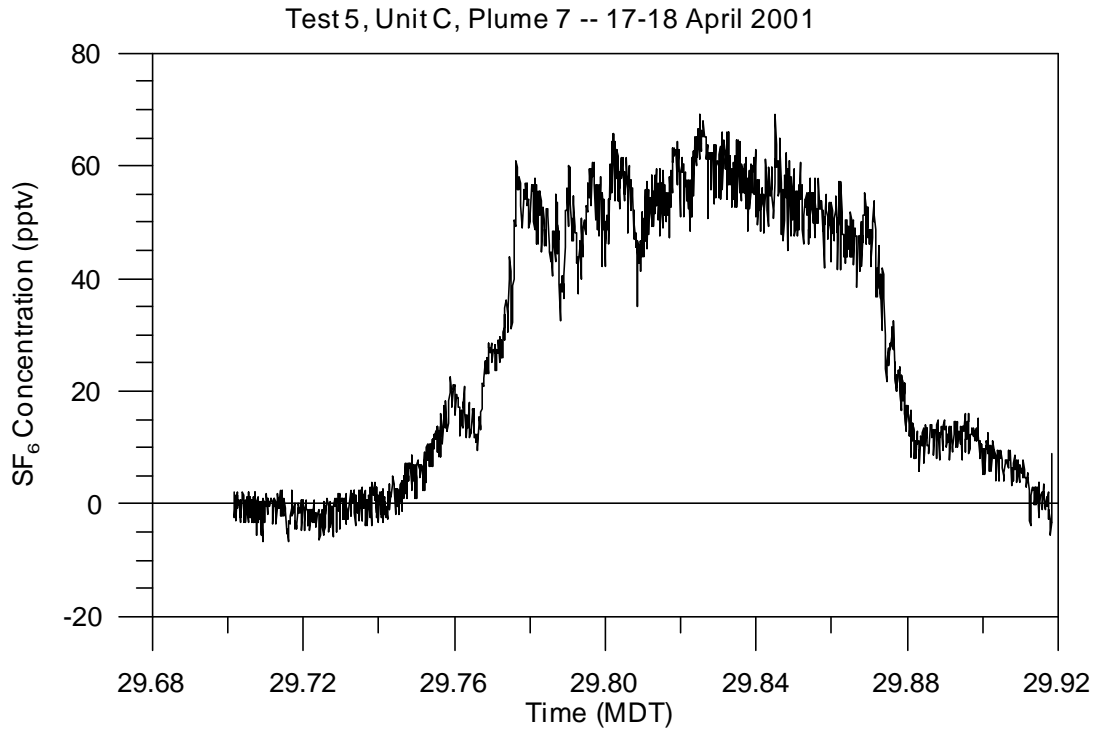


Figure A-196. SF₆ concentration of Plume 7 for Sampling Unit C during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

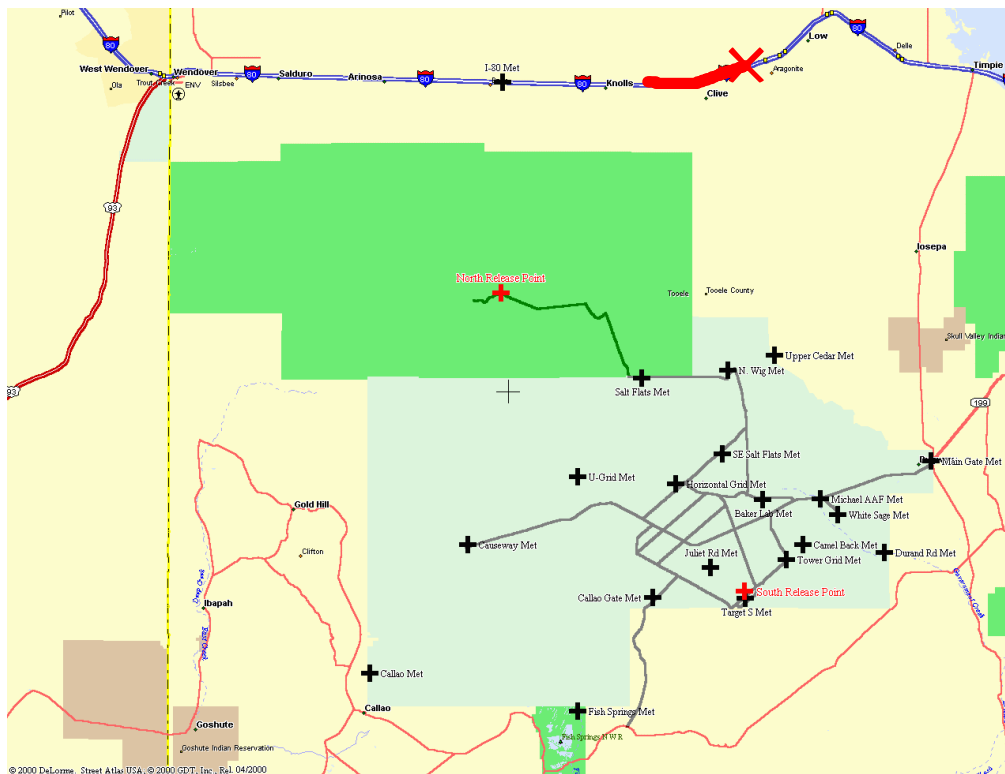
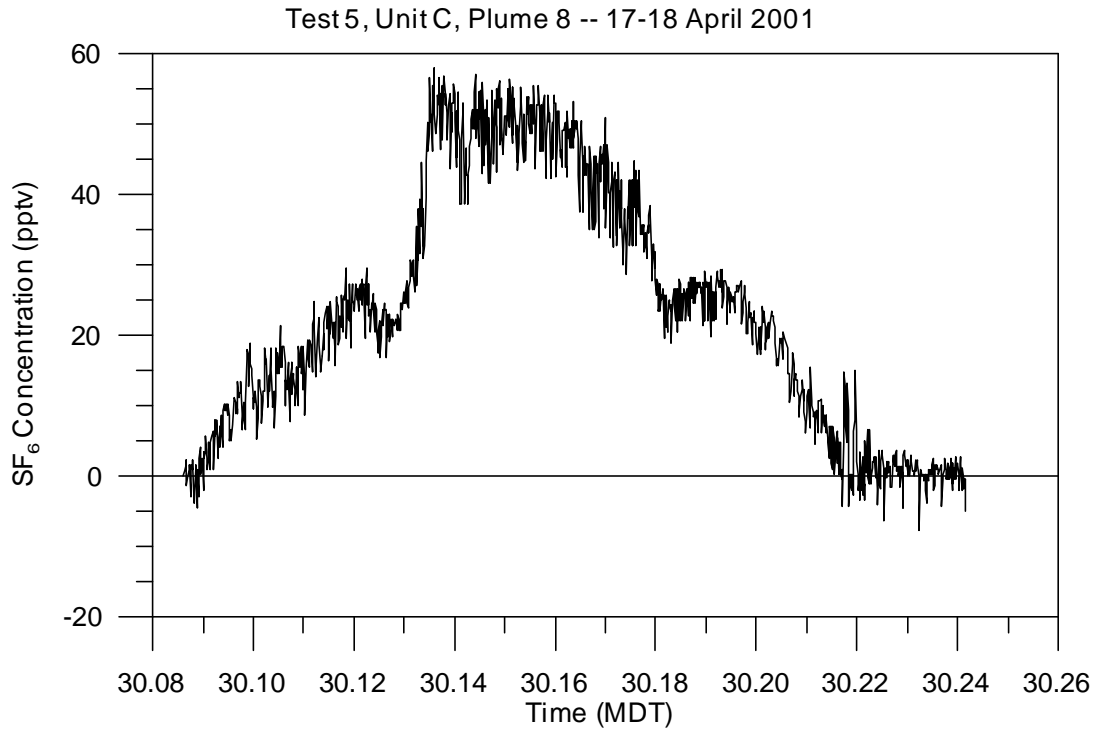


Figure A-197. SF₆ concentration of Plume 8 for Sampling Unit C during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

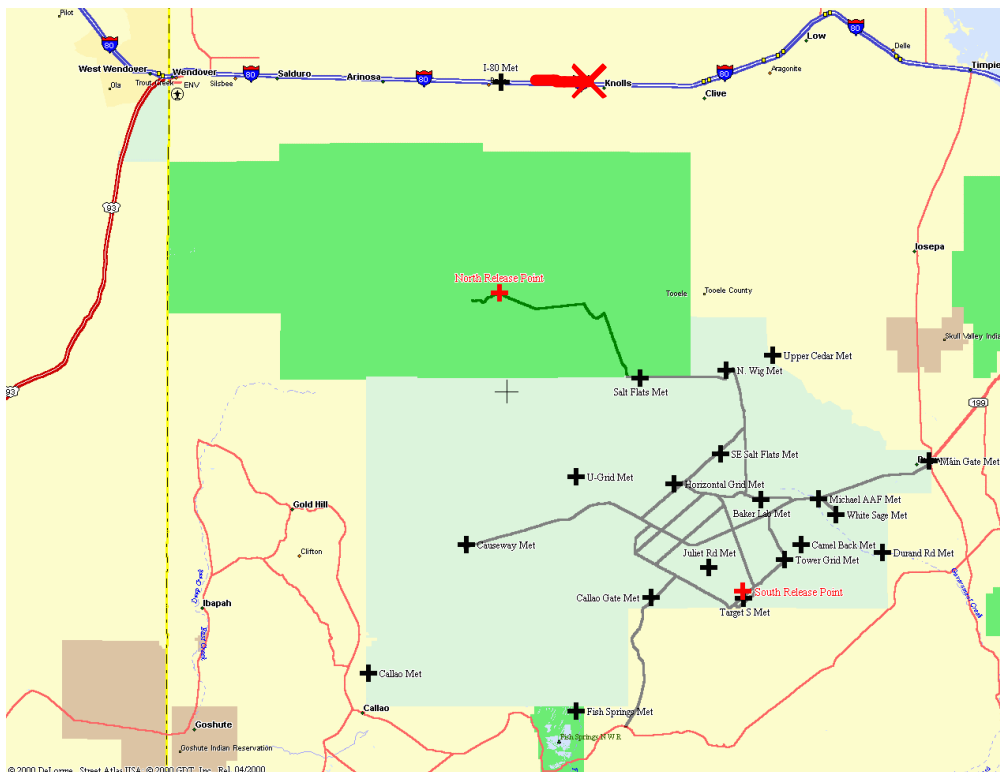
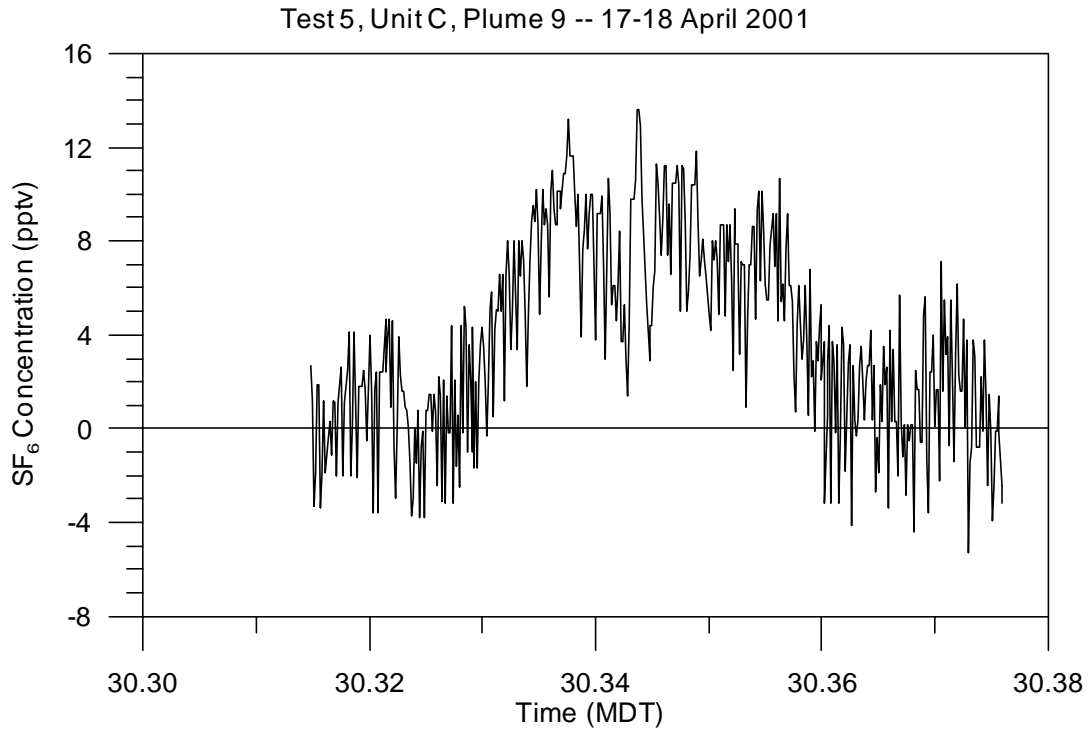


Figure A-198. SF₆ concentration of Plume 9 for Sampling Unit C during Test 5 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 6 Sampling Unit A

Table A-52. Test 6 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	1:11	1:34
2	1:42	2:07

Table A-53. Summary of individual SF₆ plume characteristics measured by Sampling Unit A during Test 6. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	2:19-2:21	221	306.5-309.9	14.85	14.96	15.03
2	2:22-2:23	181	302.8-305.8	15.07	15.17	15.28
3	2:24-2:29	581	292.6-301.8	15.37	15.90	16.41
4	2:38-2:59	2481	289.2-322.9	14.65	15.74	16.95
5	3:07-3:21	1701	291.1-322.6	14.65	15.33	16.64
6	3:29-3:44	1841	291.0-327.0	14.65	15.39	16.65
7	3:56-4:25	3417	283.7-327.1	10.66	14.79	16.93
8	4:37-5:06	3441	283.6-335.7	10.61	15.02	16.93
9	5:14-5:53	4601	283.0-338.1	10.22	14.51	16.94
10	5:53-6:32	4641	283.0-338.0	10.20	14.39	16.94
11	6:55-7:25	3683	279.9-337.6	8.57	14.21	16.94
12	7:32-8:07	4185	279.9-337.8	8.57	14.04	16.94
13	8:23-8:27	546	359.7-17.0	13.83	14.11	14.47

Table A-54. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit A during Test 6.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	267.5	2:21	40.139905	113.191607	307.0	15.00
2	170.6	2:22	40.136317	113.197052	304.7	15.14
3	448.3	2:26	40.121785	113.219172	296.1	15.96
4	1424.0	2:48	40.124013	113.215753	297.3	15.81
5	3461.4	3:10	40.150062	113.176258	313.6	14.73
6	3152.2	3:40	40.148152	113.179127	312.3	14.76
7	2726.6	4:01	40.153053	113.171720	315.5	14.69
8	2044.5	5:00	40.155720	113.167703	317.3	14.66
9	2070.6	5:22	40.156150	113.167077	317.6	14.66
10	2126.1	6:24	40.151570	113.174068	314.5	14.71
11	1879.8	6:59	40.167265	113.150198	325.0	14.72
12	1835.1	7:46	40.108627	113.237762	289.2	16.86
13	139.8	8:26	40.182332	113.022525	10.1	13.95

No null passes were made by Sampling Unit A either during or after the time period of active plume sampling listed in the previous two tables.

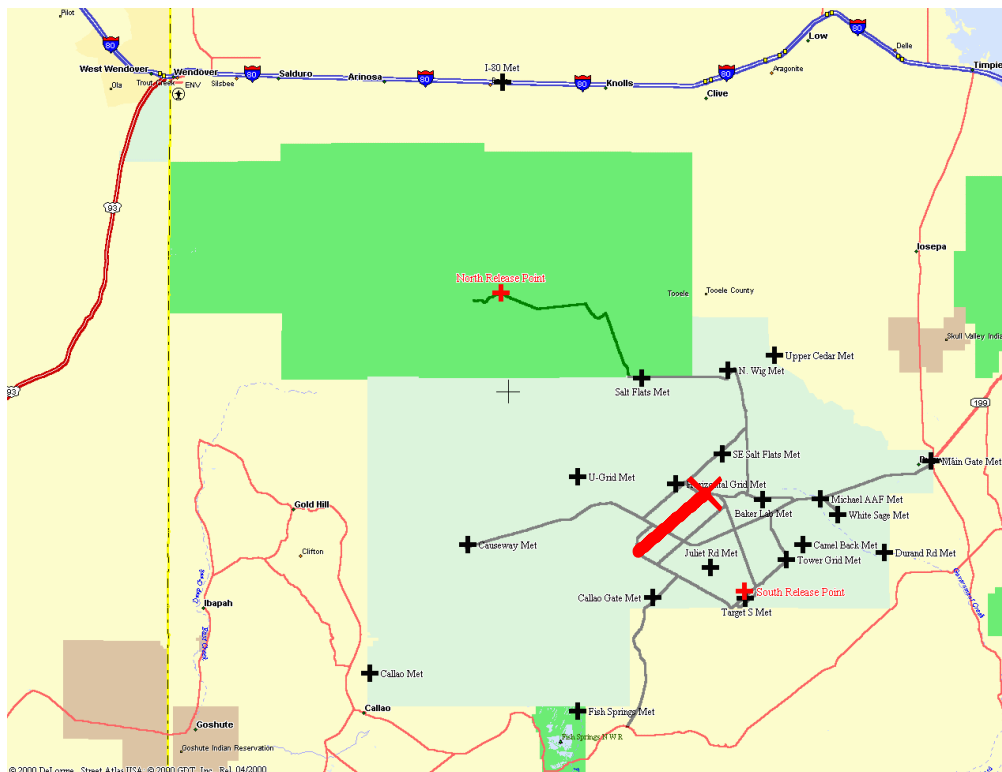
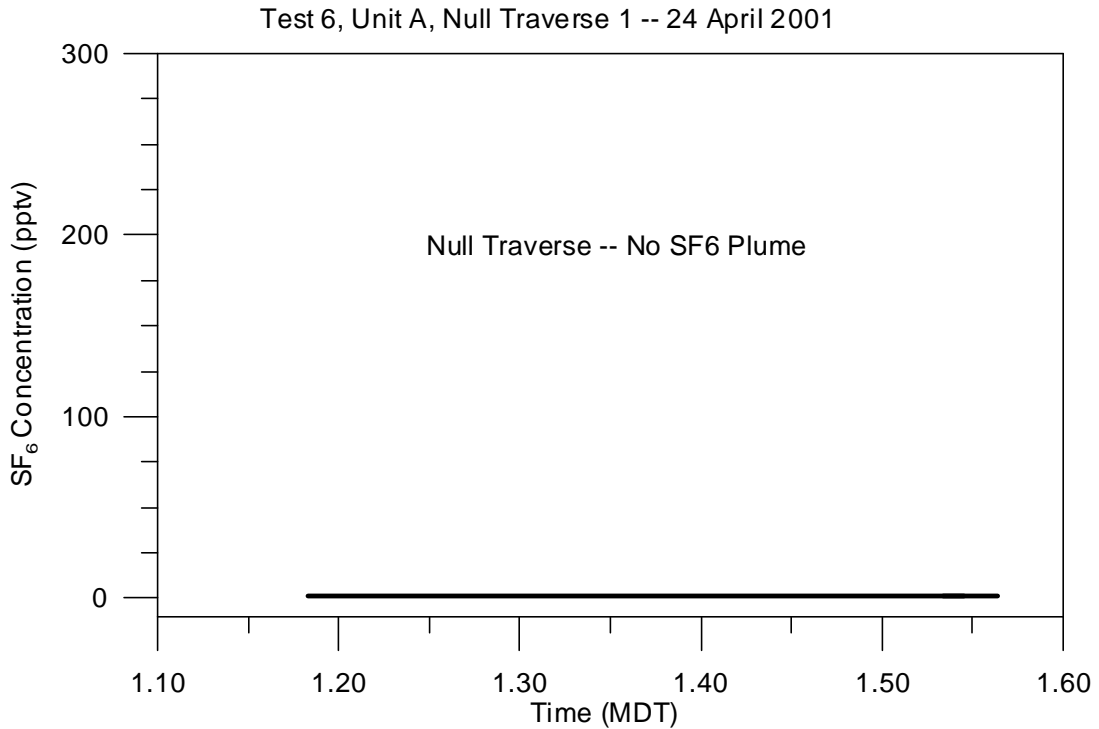


Figure A-199. Null sampling traverse 1 made by Sampling Unit A during Test 6, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

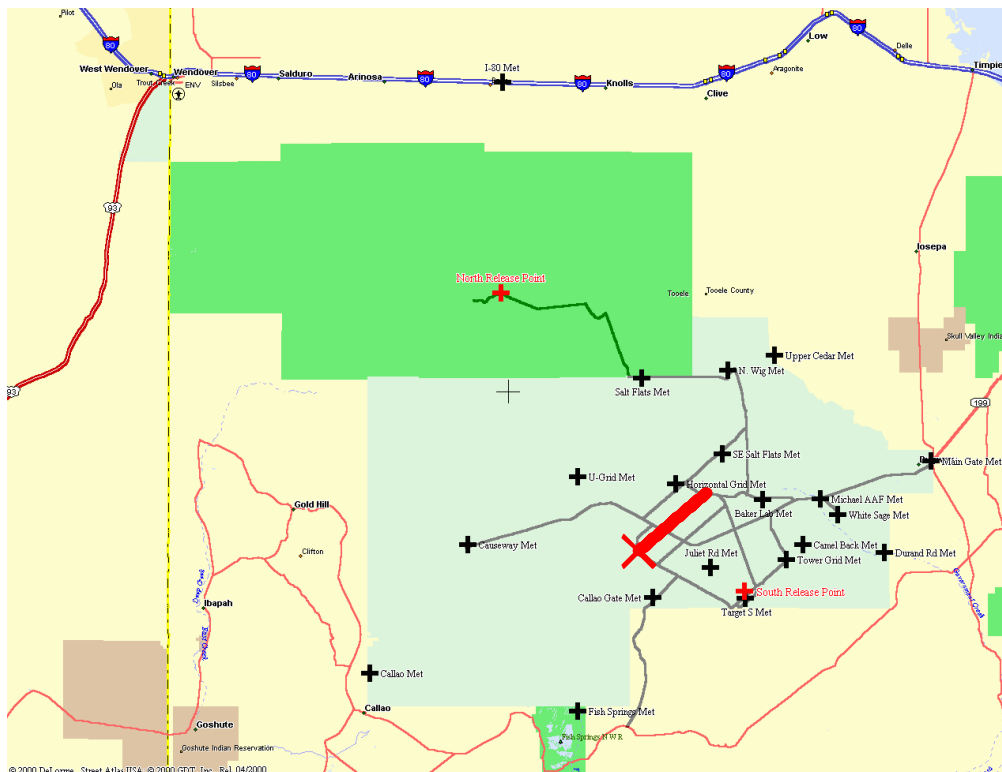
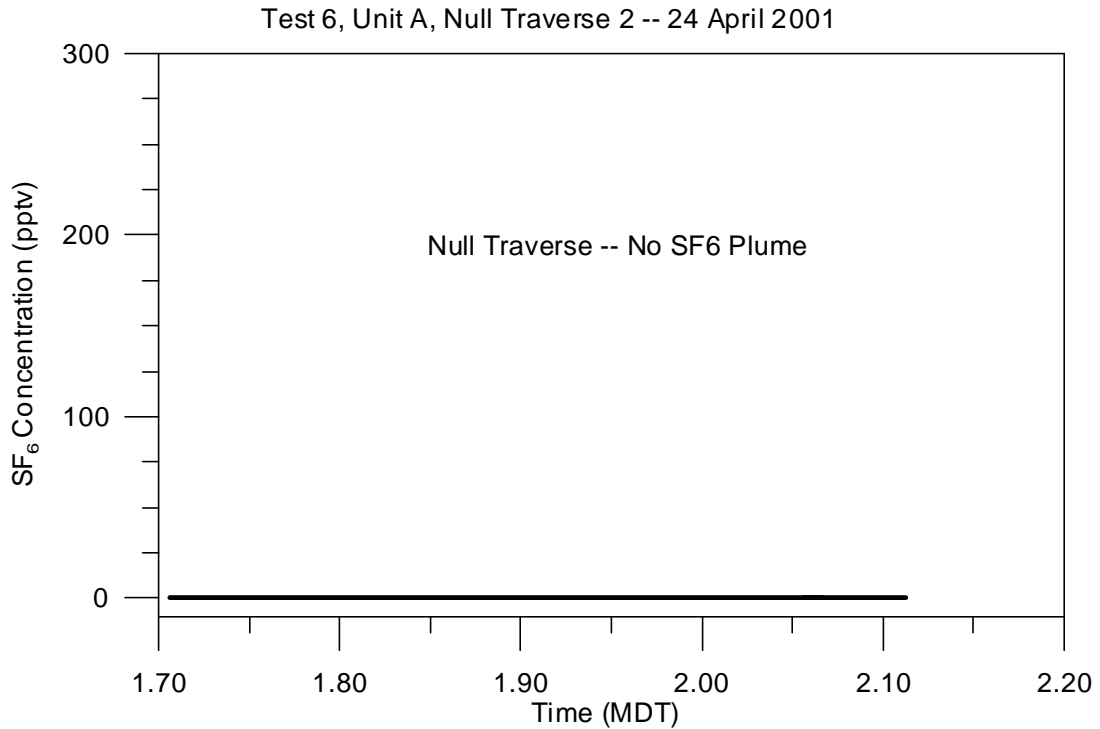


Figure A-200. Null sampling traverse 2 made by Sampling Unit A during Test 6, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

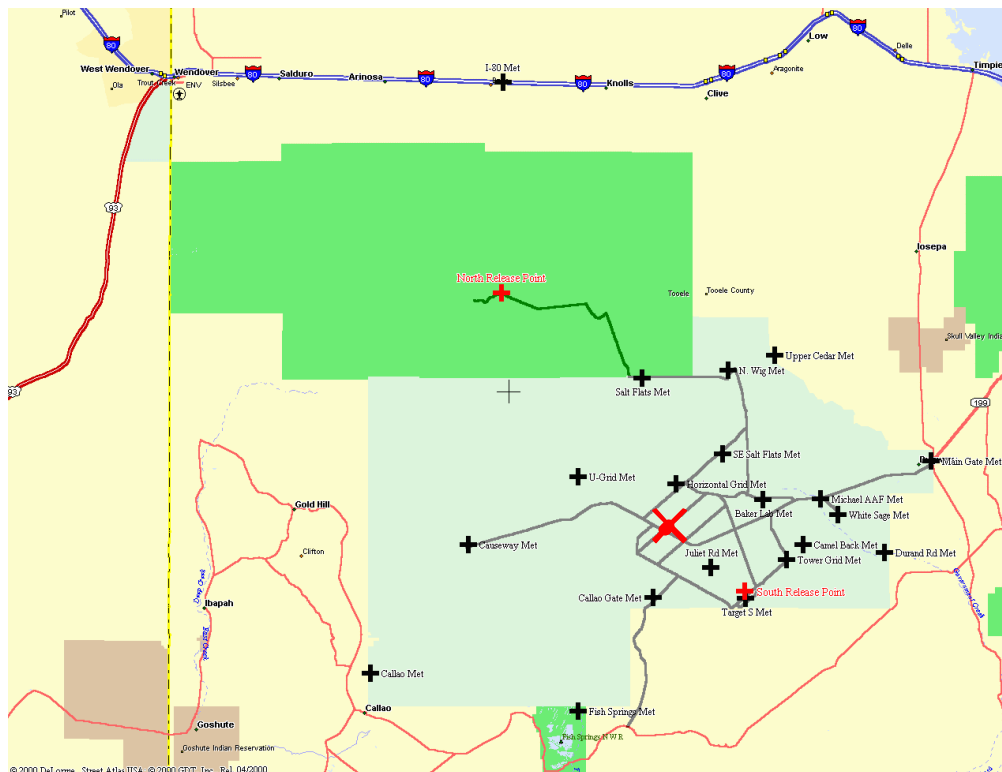
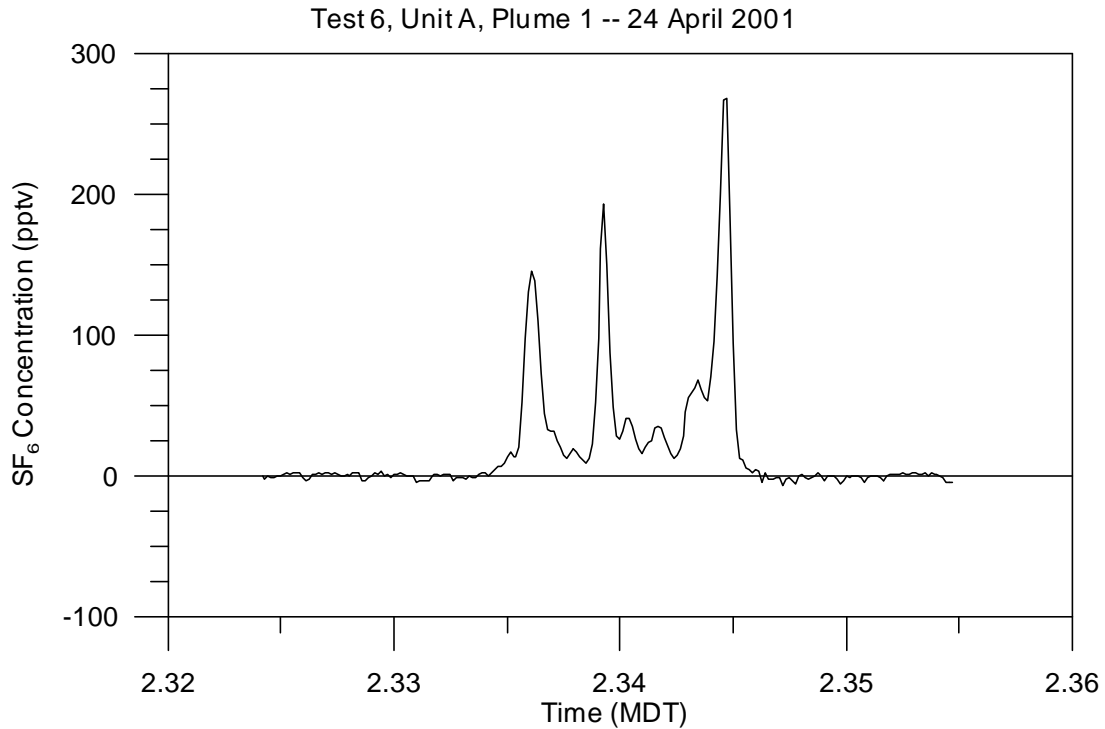


Figure A-201. SF₆ concentration of Plume 1 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

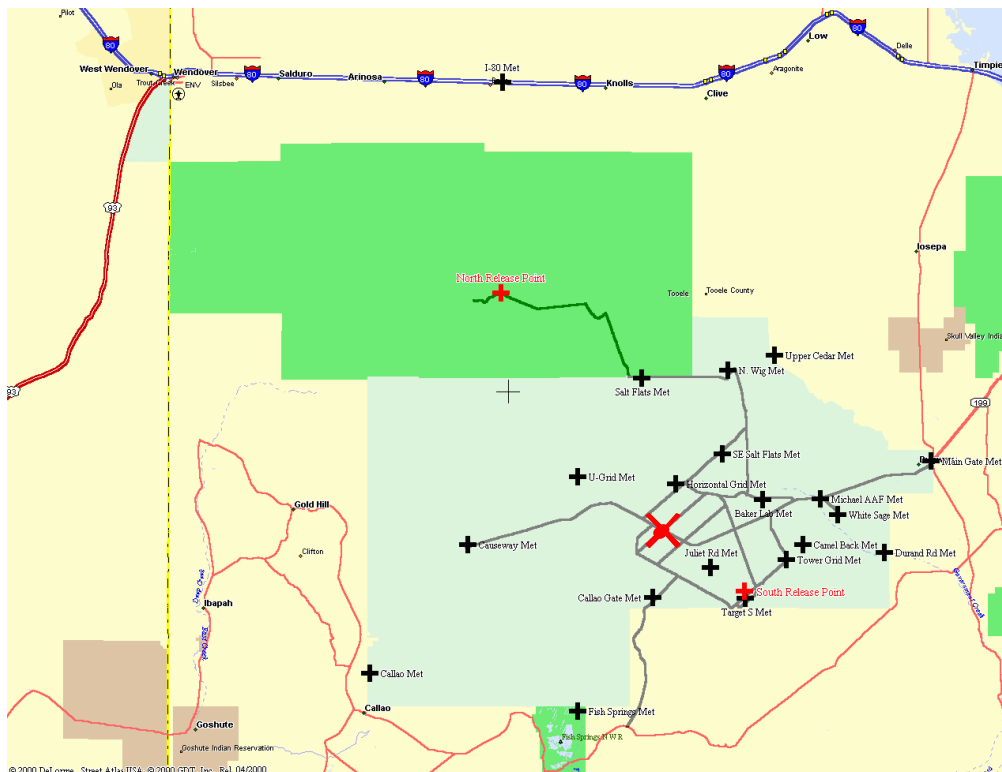
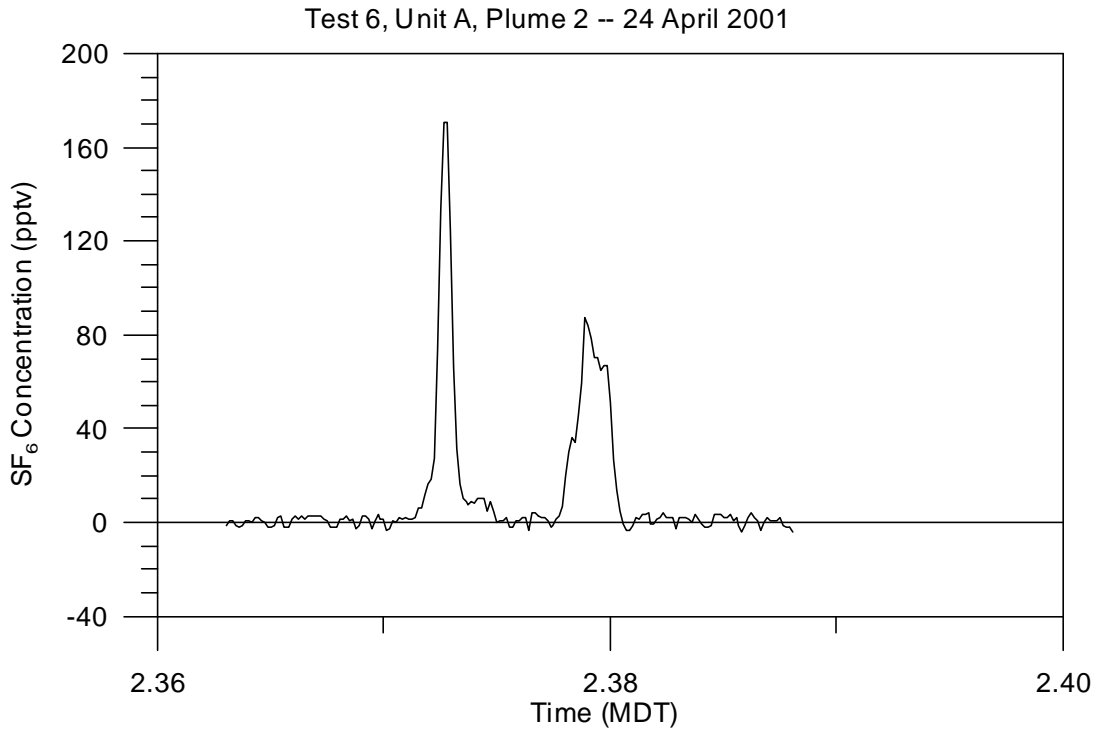


Figure A-202. SF₆ concentration of Plume 2 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

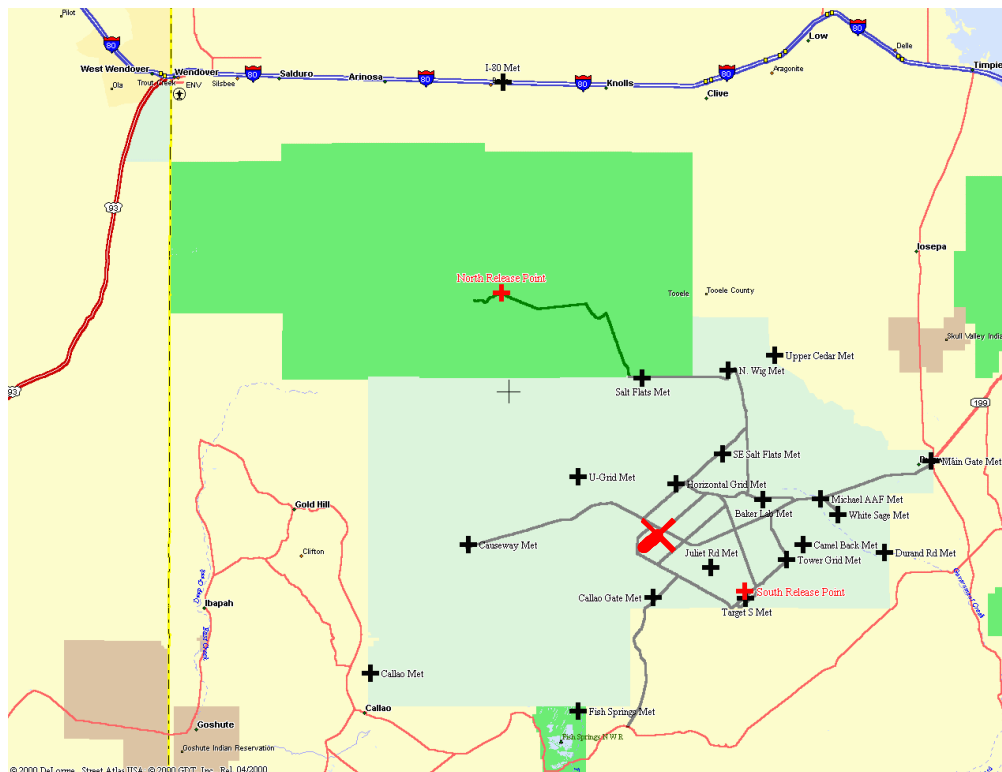
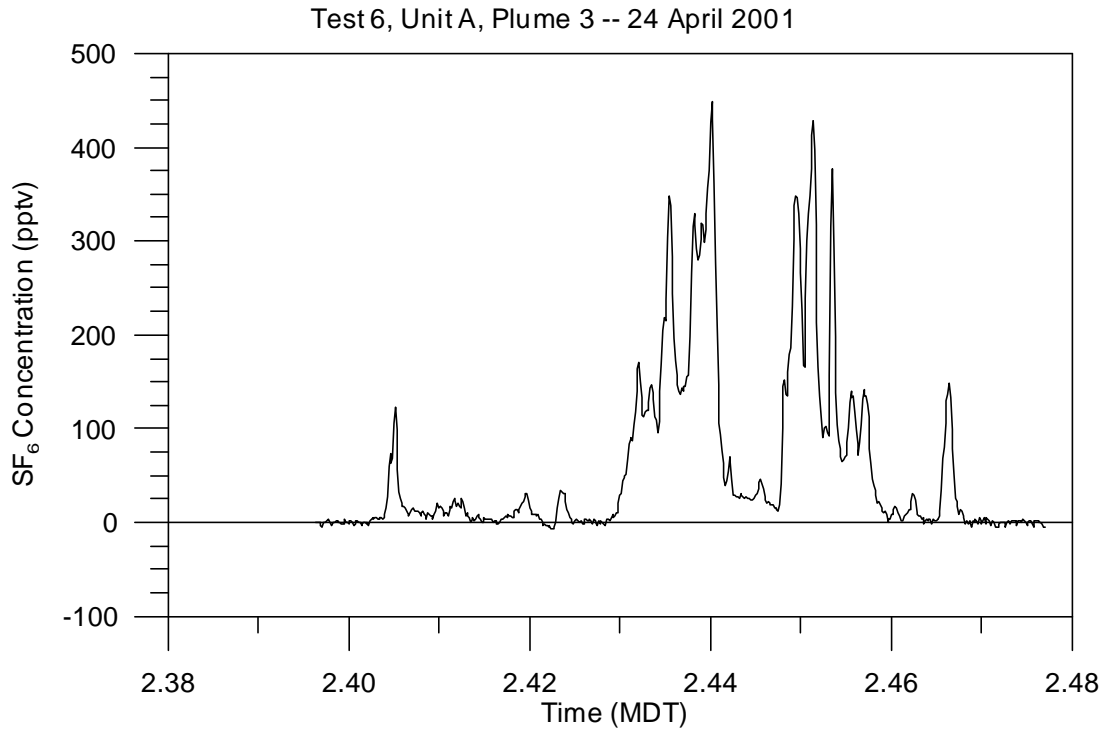


Figure A-203. SF₆ concentration of Plume 3 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

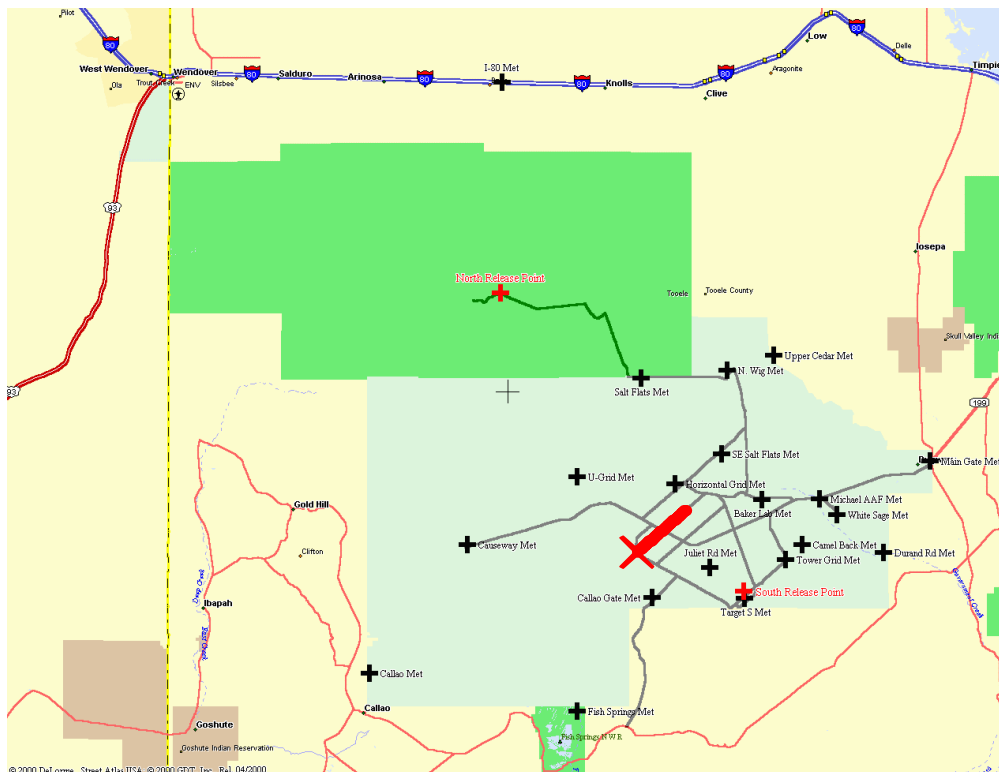
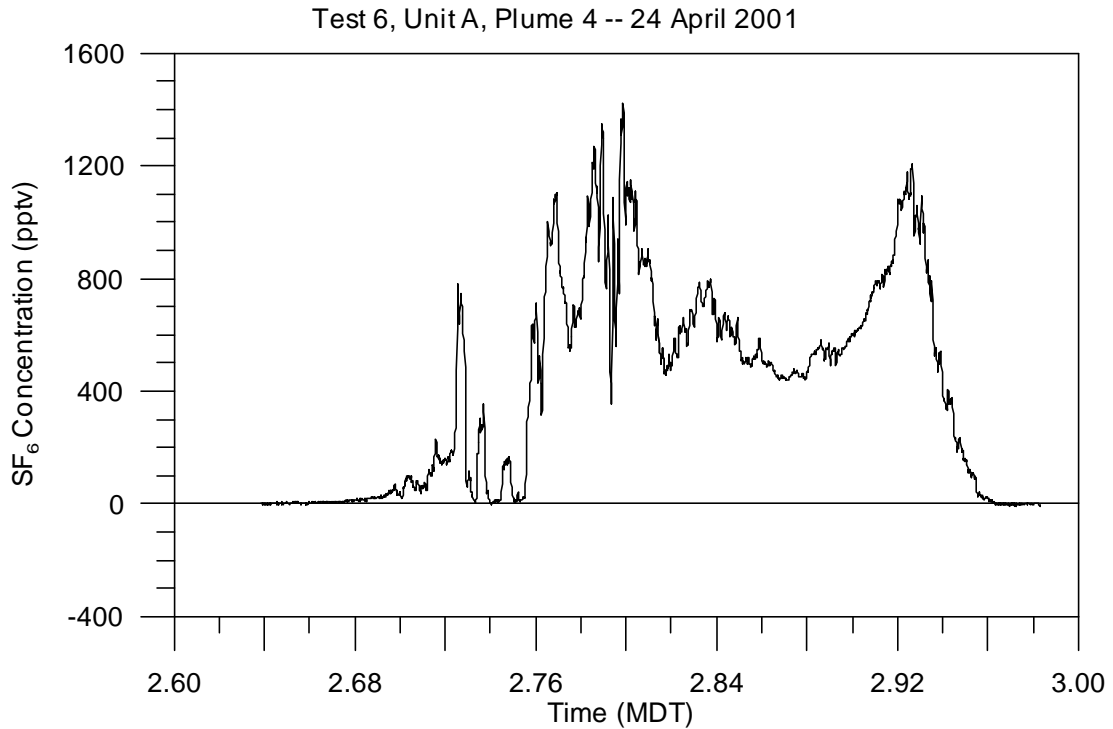


Figure A-204. SF₆ concentration of Plume 4 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

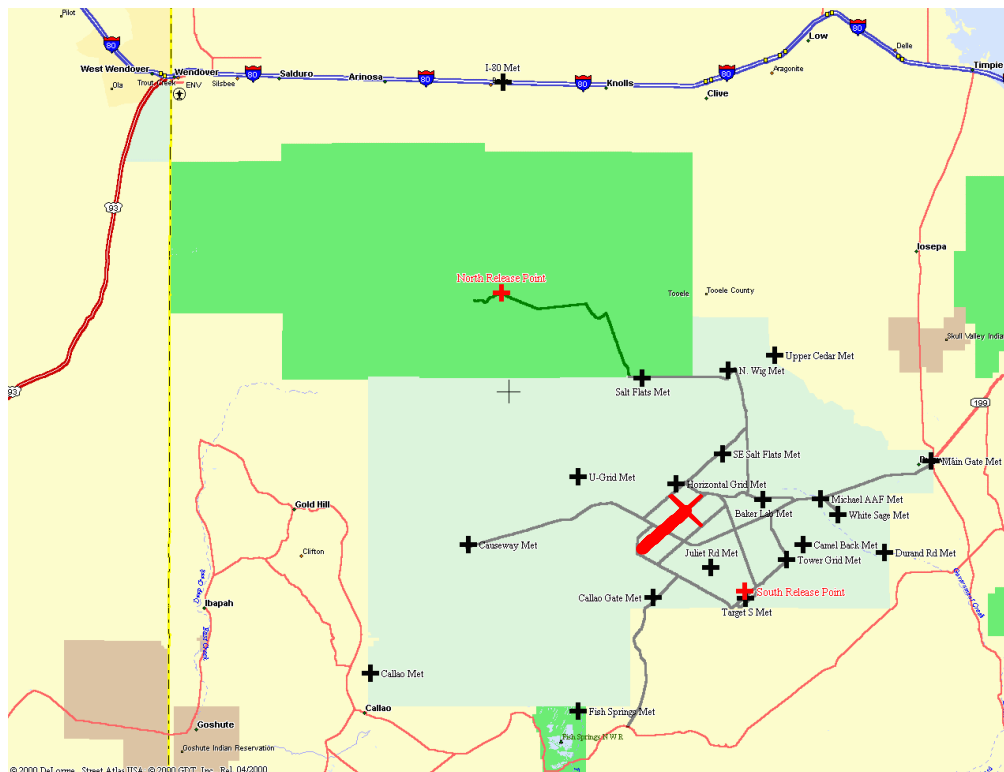
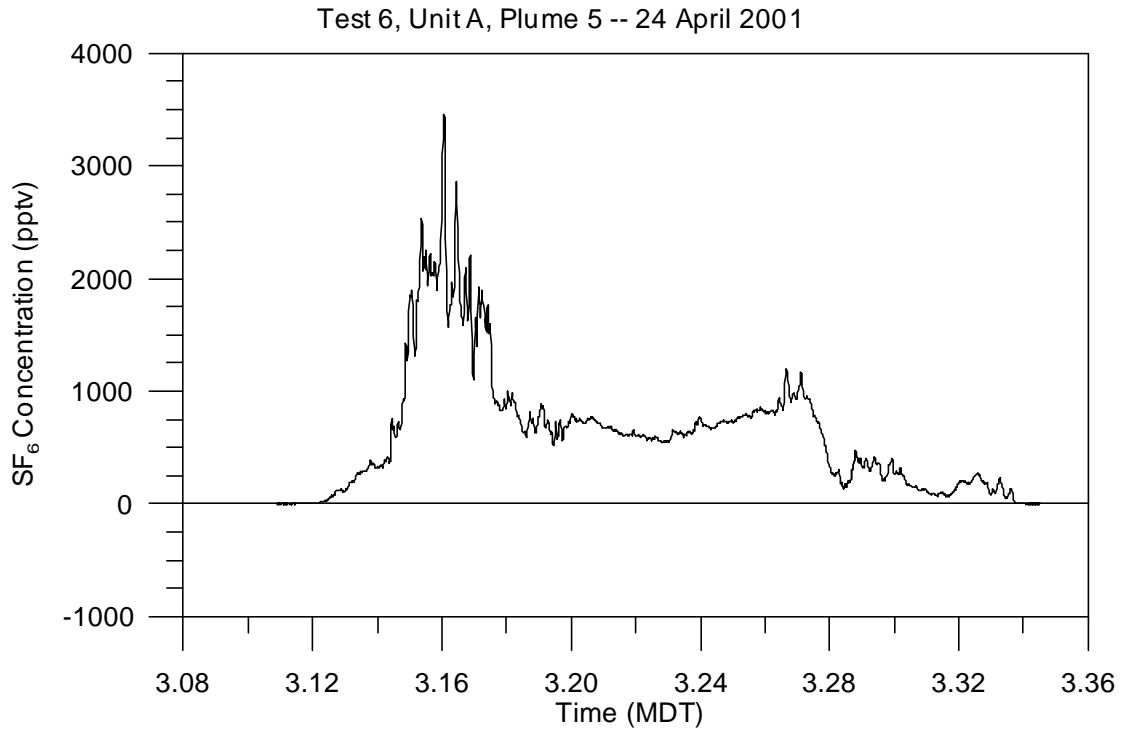


Figure A-205. SF₆ concentration of Plume 5 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

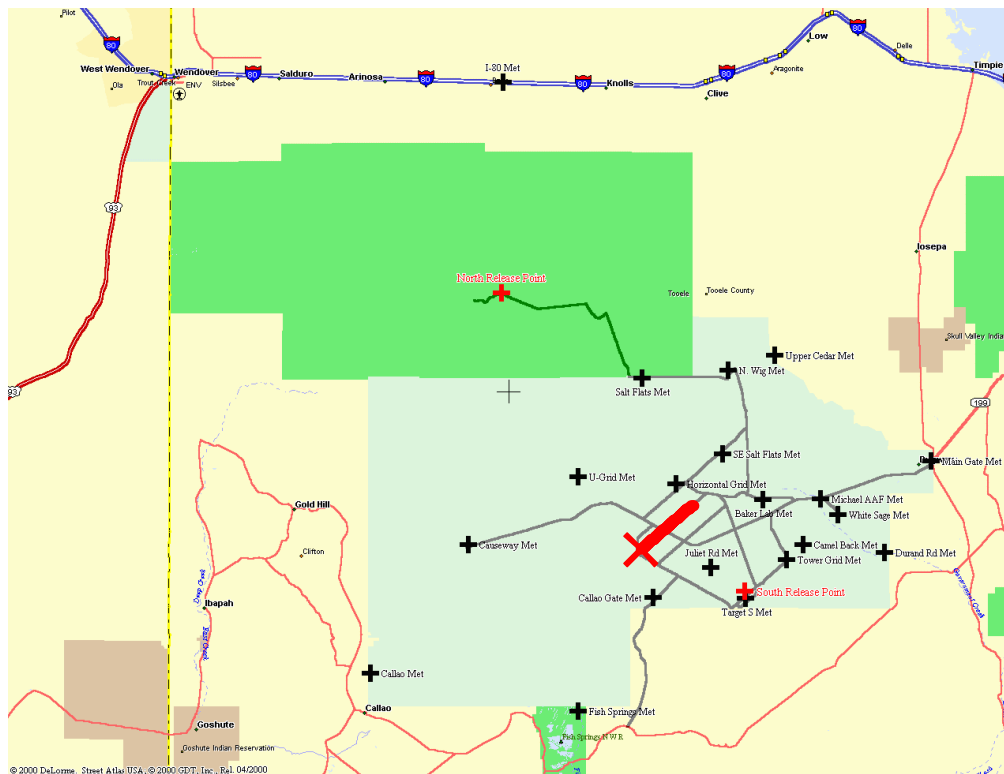
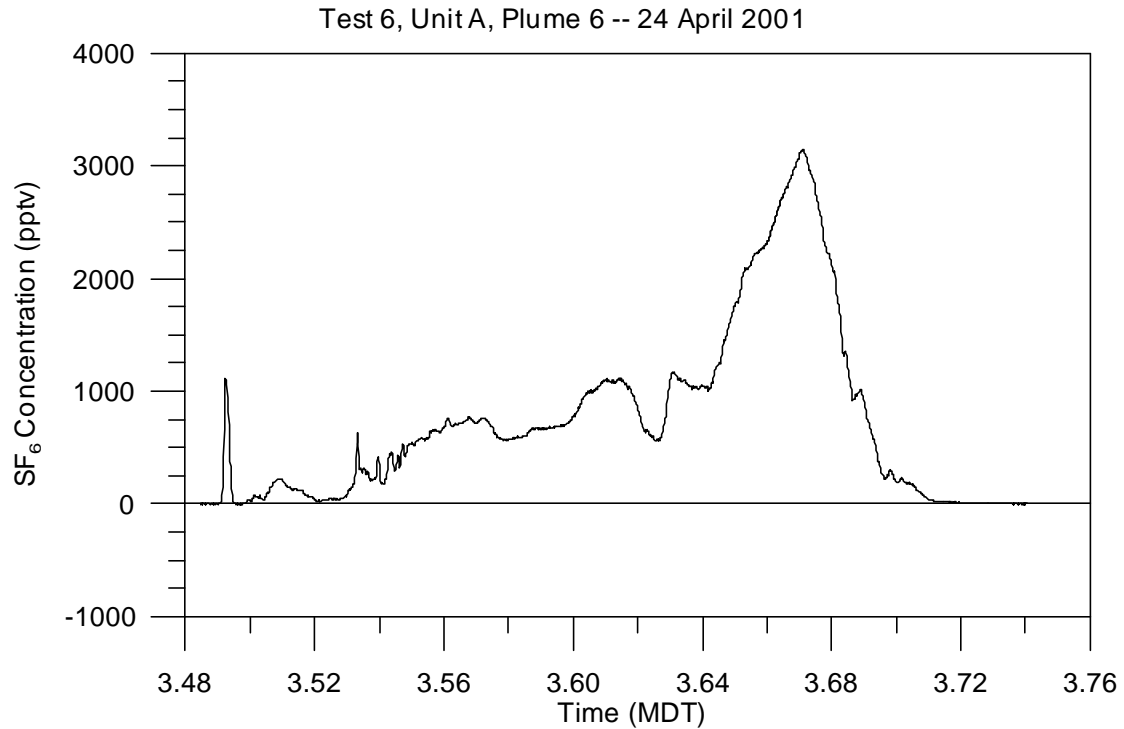


Figure A-206. SF₆ concentration of Plume 6 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

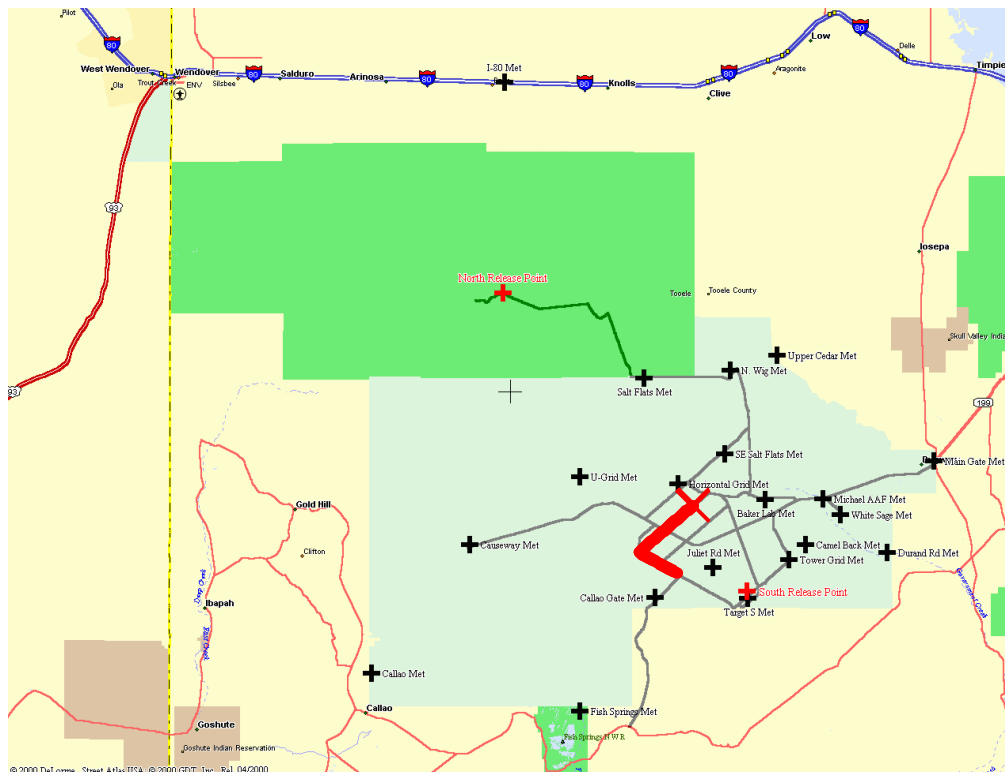
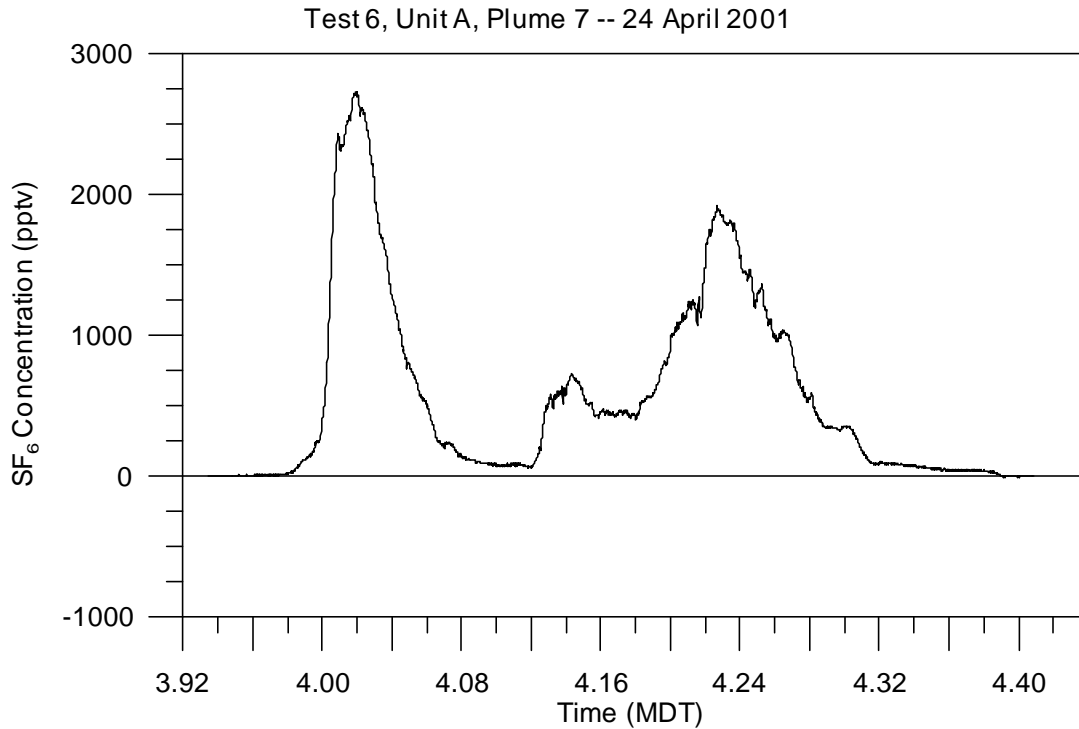


Figure A-207. SF₆ concentration of Plume 7 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

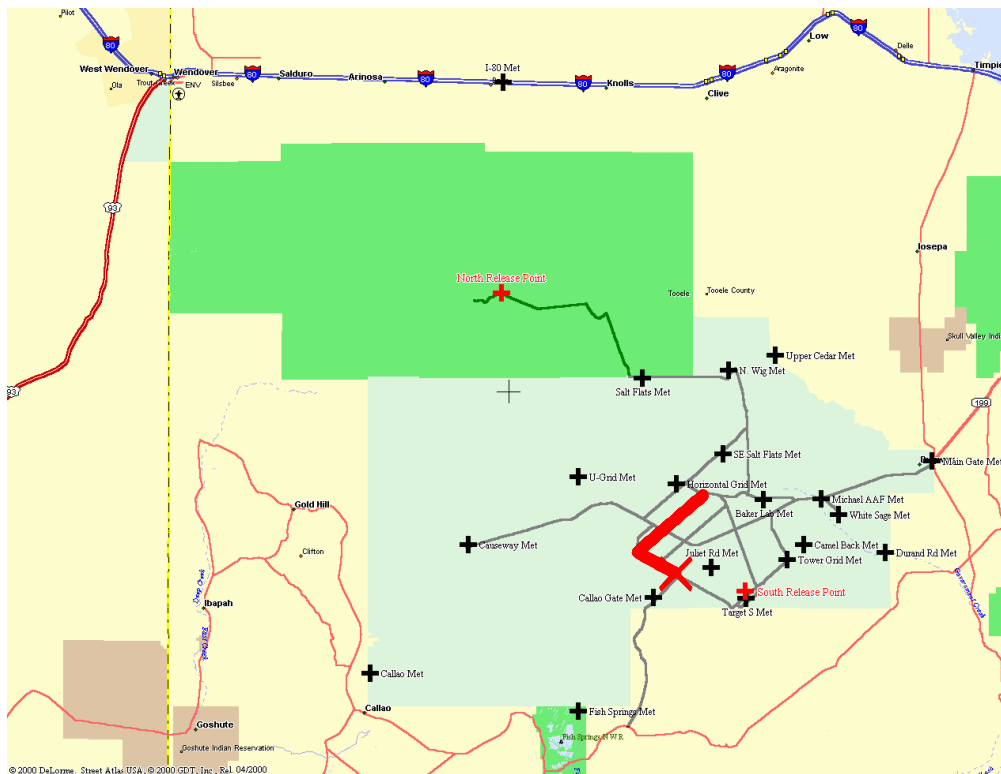
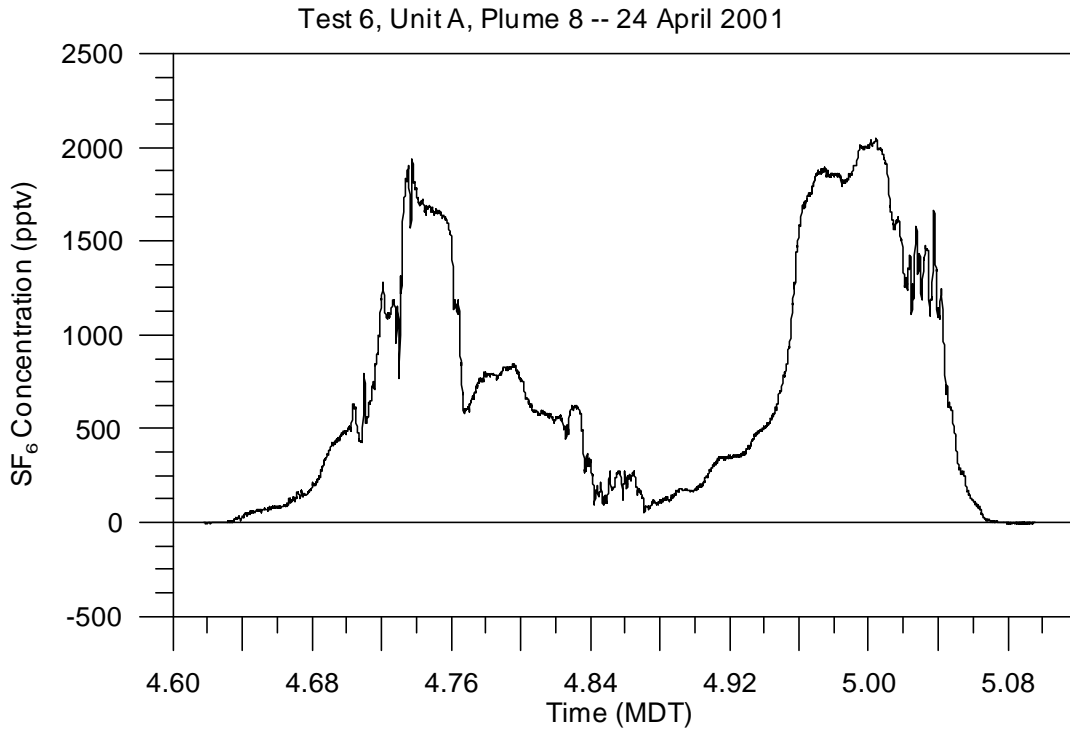


Figure A-208. SF₆ concentration of Plume 8 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

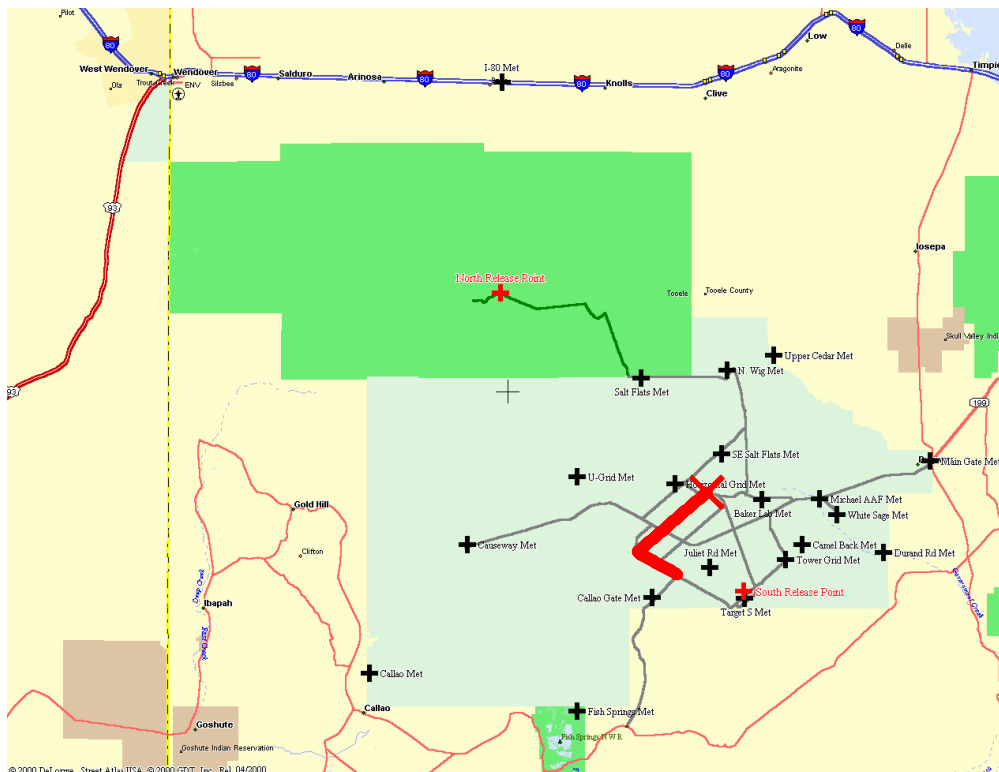
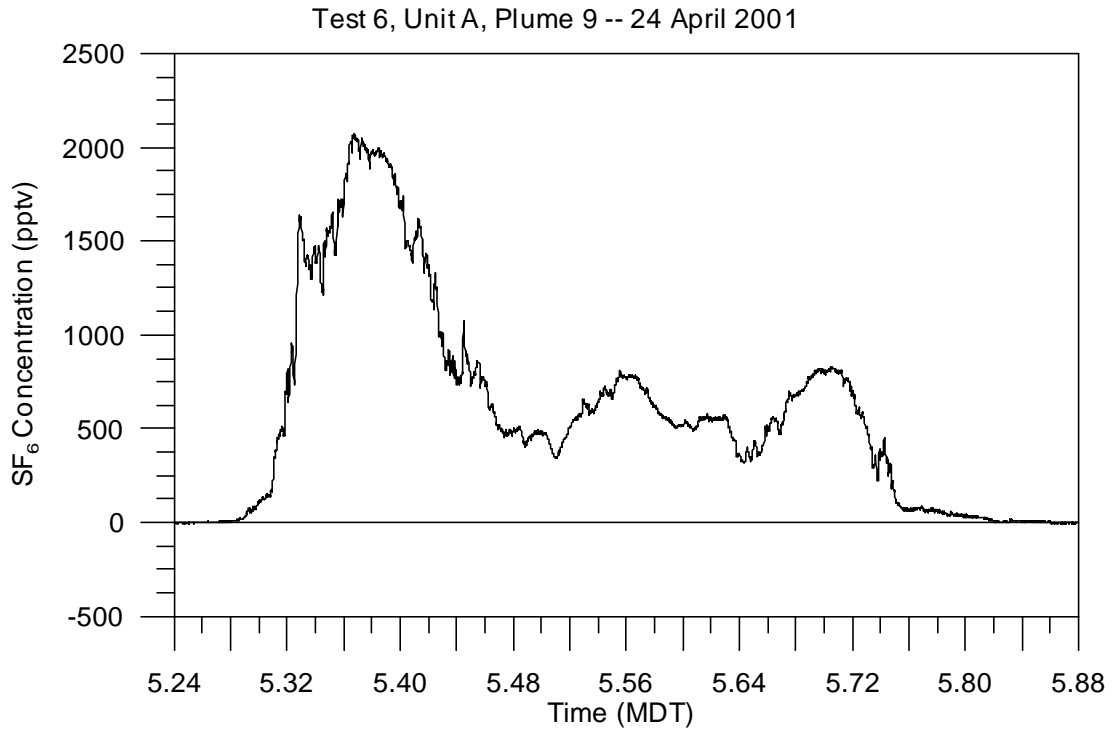


Figure A-209. SF₆ concentration of Plume 9 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

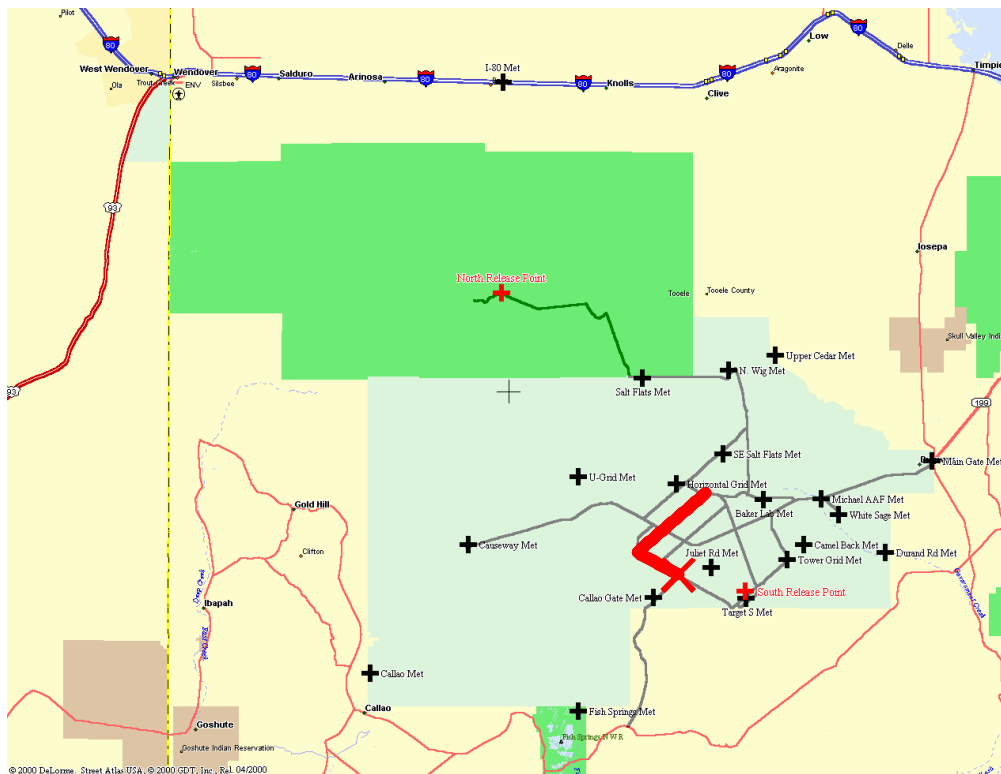
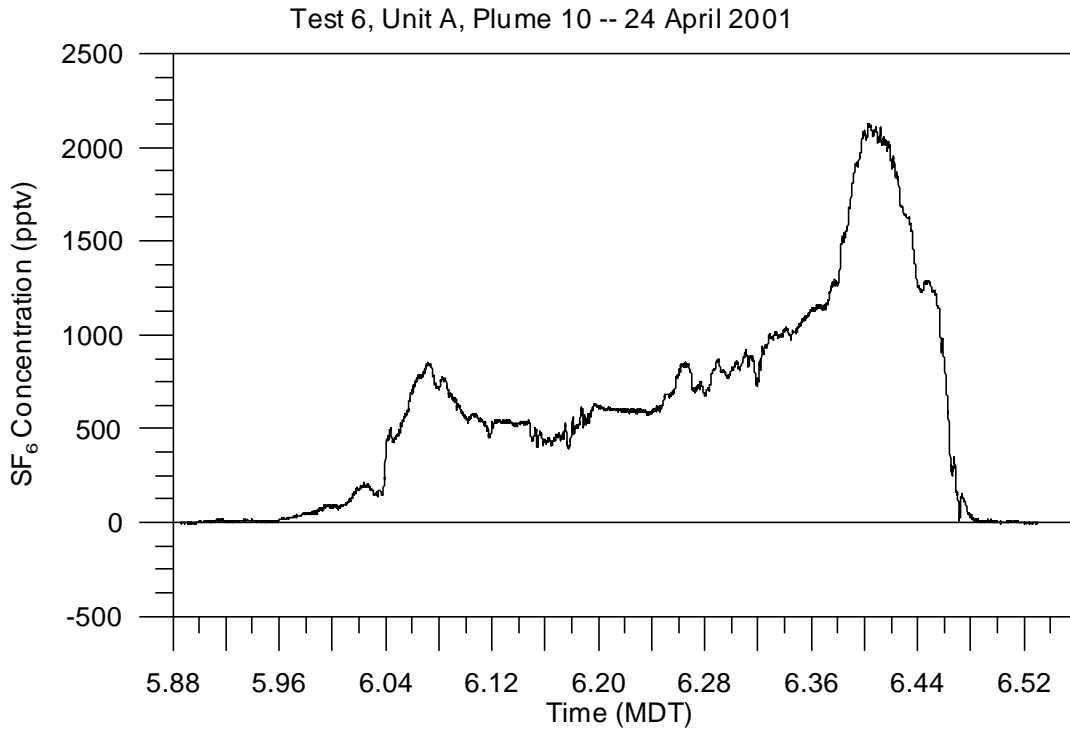


Figure A-210. SF₆ concentration of Plume 10 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

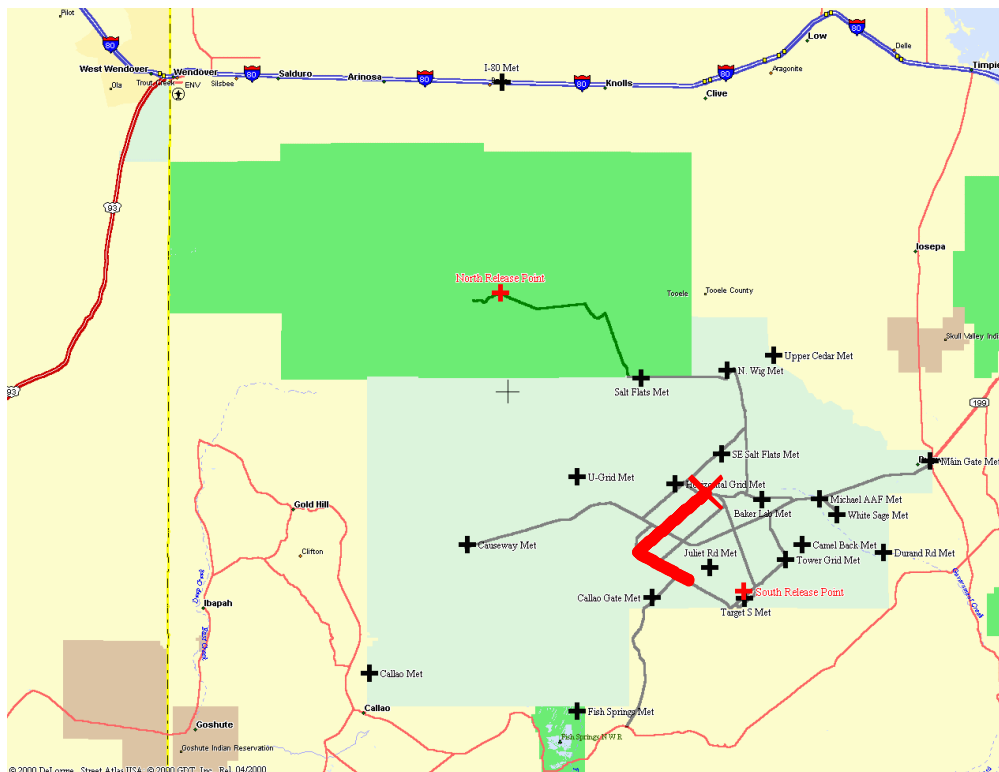
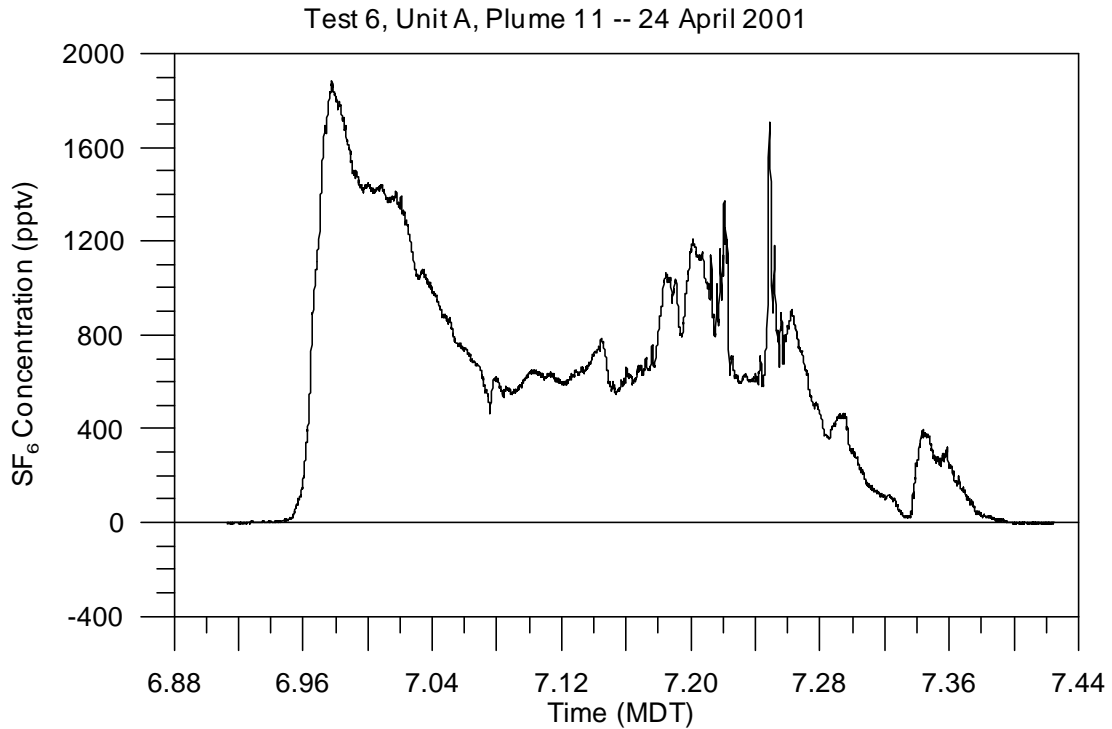


Figure A-211. SF₆ concentration of Plume 11 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

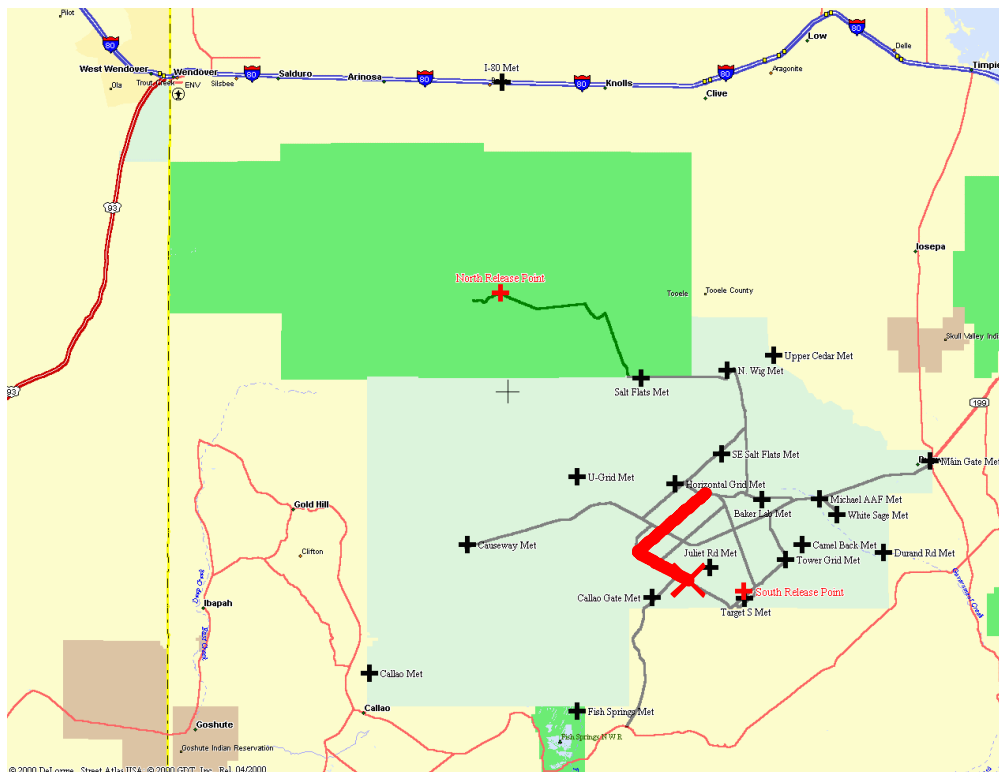
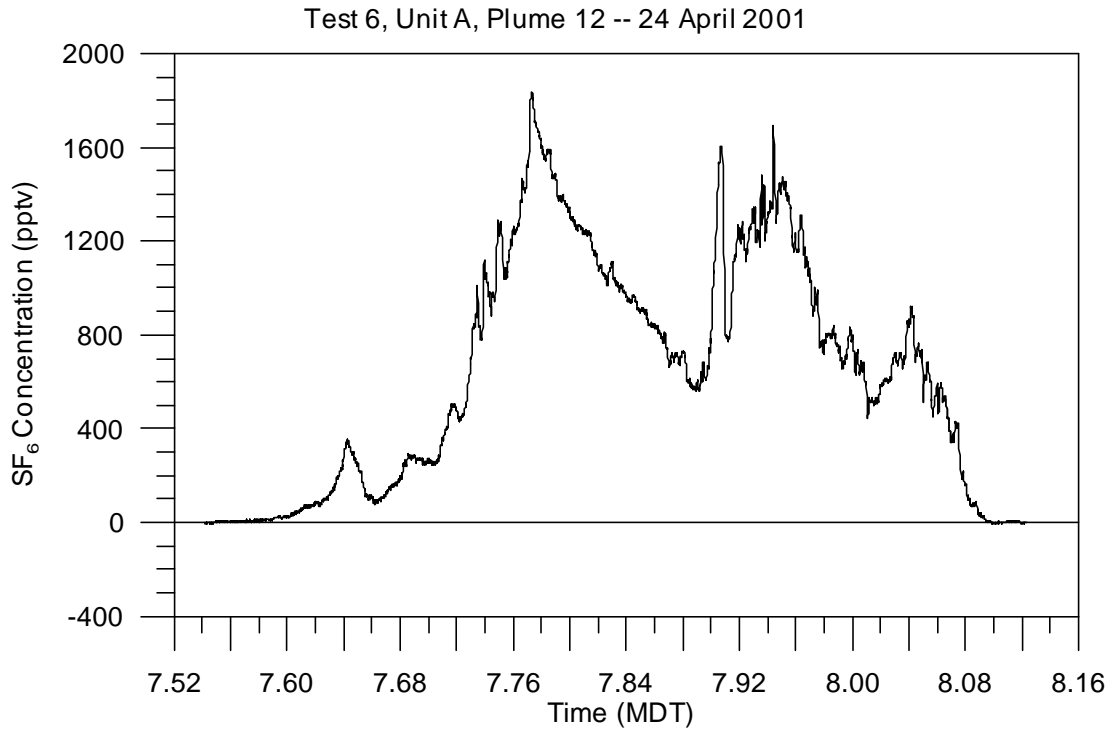


Figure A-212. SF₆ concentration of Plume 12 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

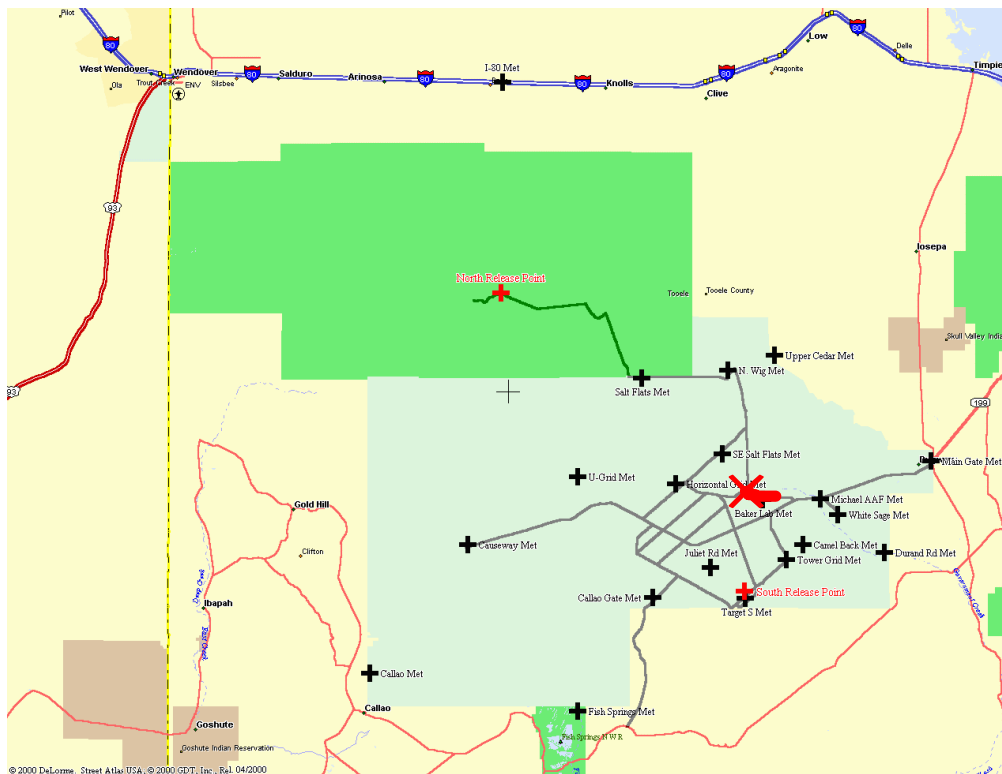
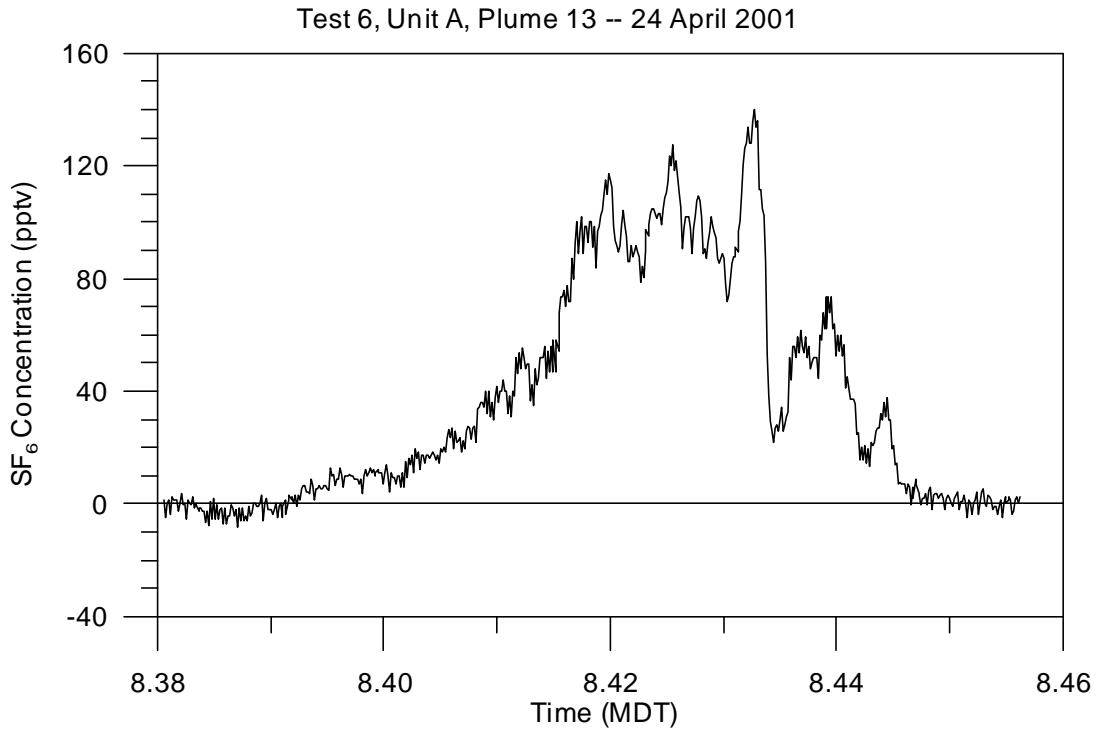


Figure A-213. SF₆ concentration of Plume 13 for Sampling Unit A during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 6 Sampling Unit B

Table A-55. Test 6 Sampling Unit B sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	1:57	2:13
2	2:22	2:31

Table A-56. Summary of individual SF₆ plume characteristics measured by Sampling Unit B during Test 6. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	2:45-3:04	2256	300.8-323.0	17.86	18.25	18.87
2	3:07-3:35	3448	299.7-330.9	17.87	18.35	18.87
3	3:48-4:25	4468	302.0-336.8	17.86	18.21	18.73
4	4:42-5:09	3248	301.3-339.6	17.86	19.54	24.44
5	5:26-5:54	3307	301.3-339.8	17.86	19.61	24.44
6	6:04-6:38	4103	301.3-339.8	17.86	19.54	24.47
7	6:45-7:12	3300	301.3-339.8	17.87	19.68	24.47
8	7:23-7:47	2776	303.3-339.8	17.87	19.20	23.65
9	7:47-8:08	2514	303.3-340.2	17.87	19.60	23.65

Table A-57. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit B during Test 6.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	2327.7	2:55	40.162658	113.215023	309.5	18.13
2	3303.5	3:27	40.172623	113.199958	314.9	17.92
3	4265.4	3:54	40.178263	113.191278	318.0	17.87
4	3154.2	4:52	40.179818	113.188945	318.8	17.87
5	2935.3	5:44	40.179552	113.189357	318.7	17.87
6	3329.3	6:32	40.170708	113.268305	303.9	22.32
7	2746.8	6:50	40.169757	113.266017	303.9	22.10
8	1809.7	7:40	40.157607	113.236098	304.8	19.23
9	1608.9	7:54	40.157998	113.237088	304.8	19.32

No null passes were made by Sampling Unit B either during or after the time period of active plume sampling listed in the previous two tables.

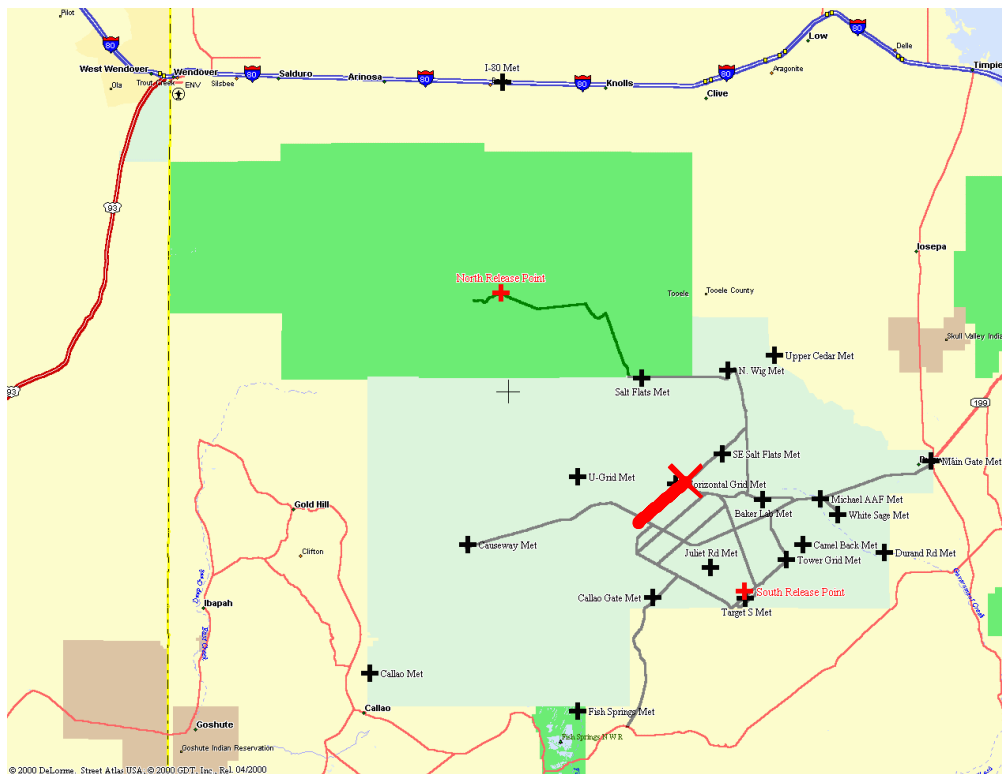
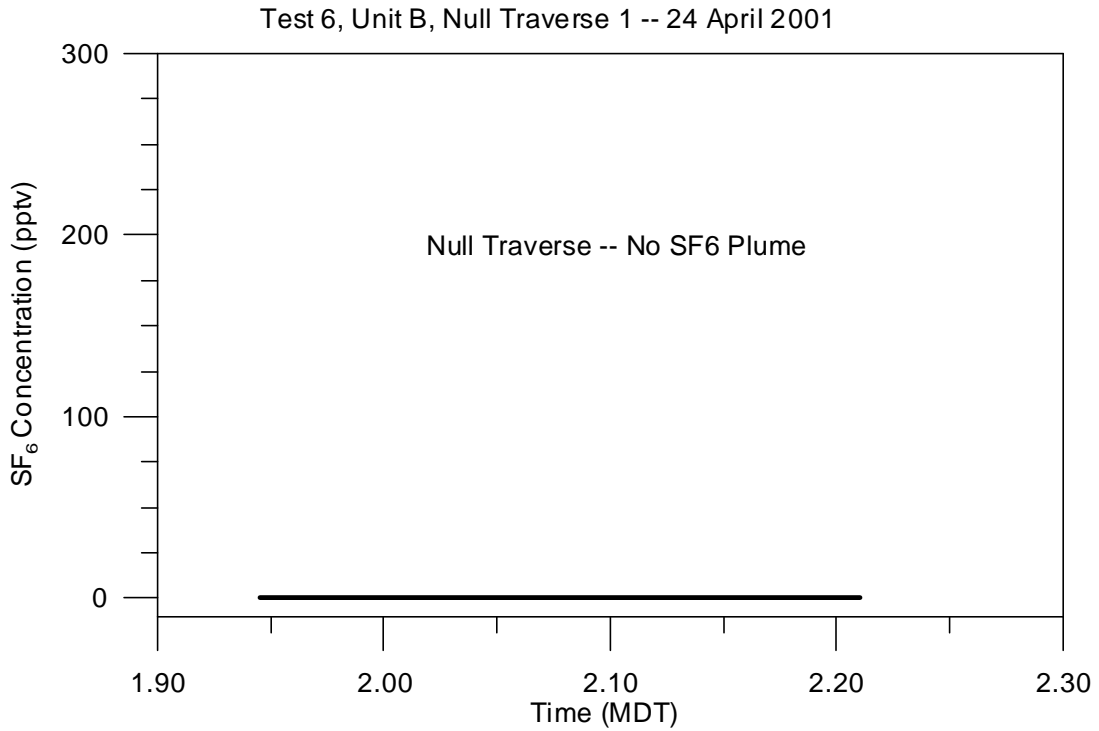


Figure A-214. Null sampling traverse 1 made by Sampling Unit B during Test 6, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

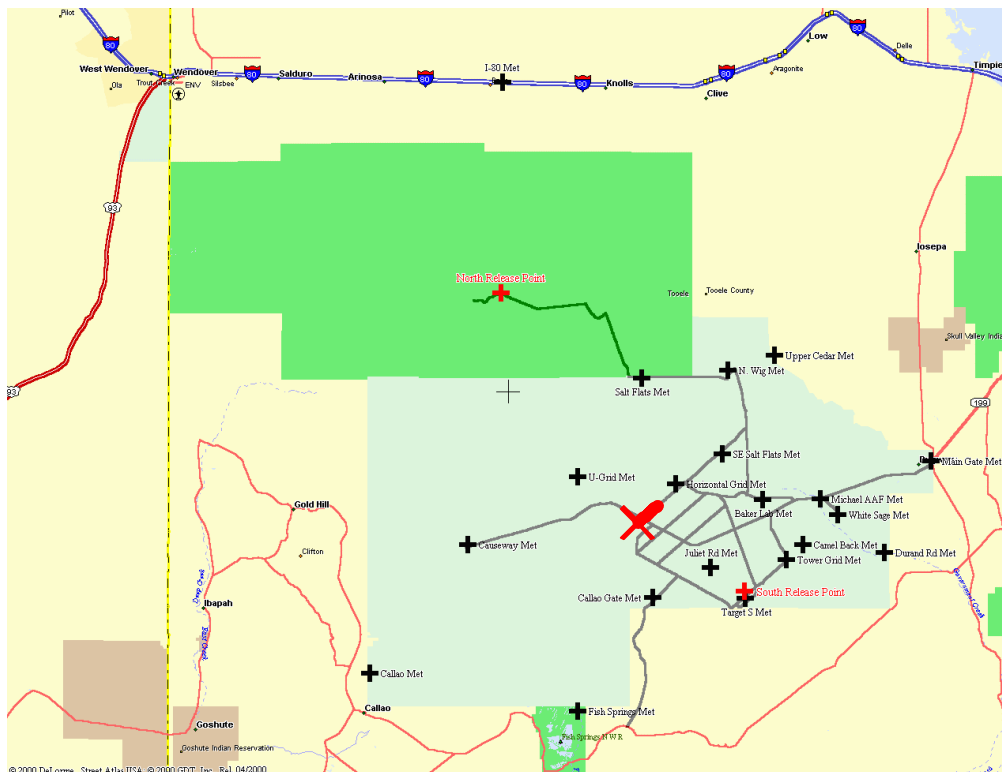
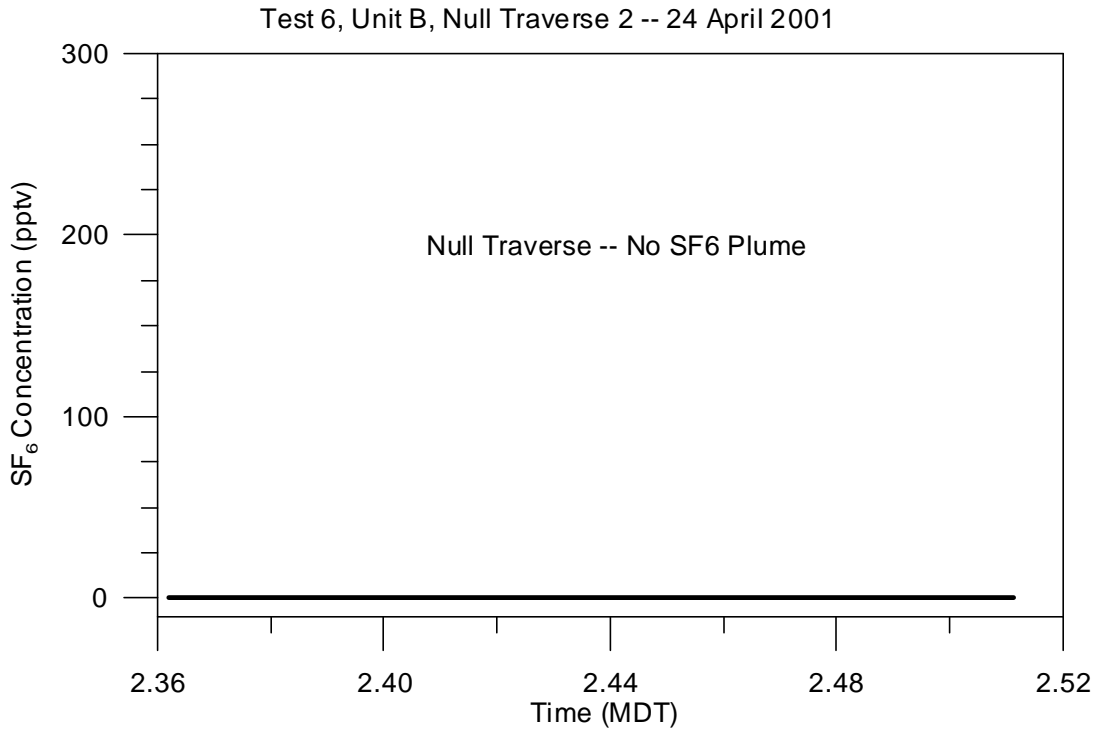


Figure A-215. Null sampling traverse 2 made by Sampling Unit B during Test 6, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

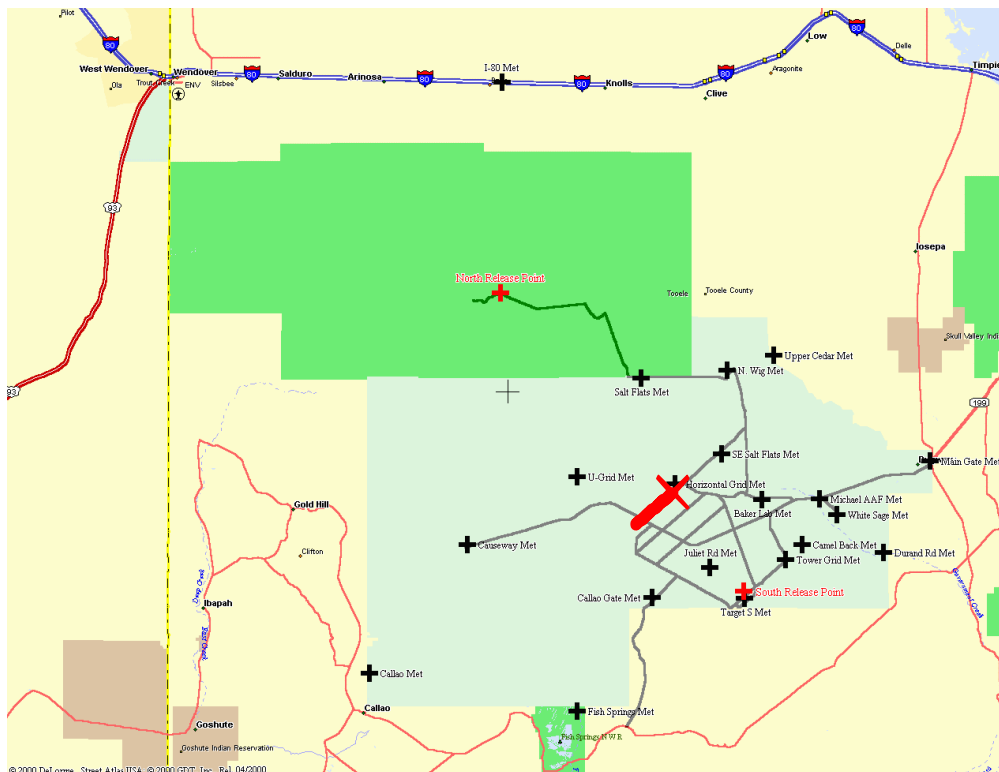
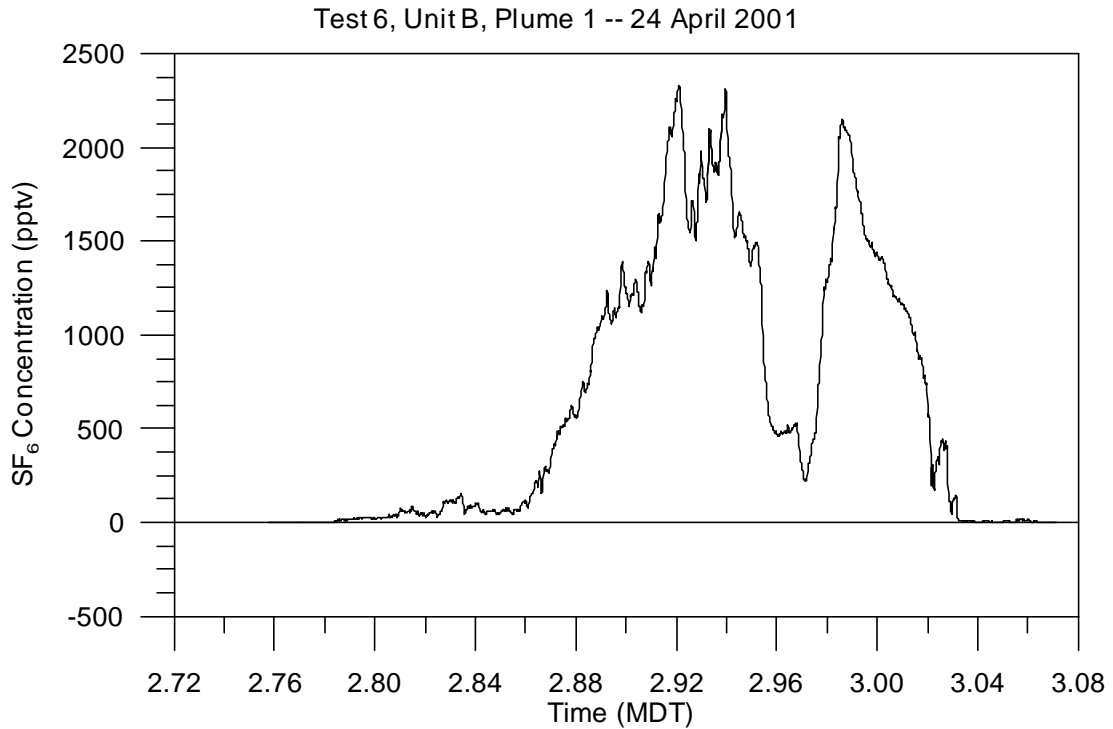


Figure A-216. SF₆ concentration of Plume 1 for Sampling Unit B during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

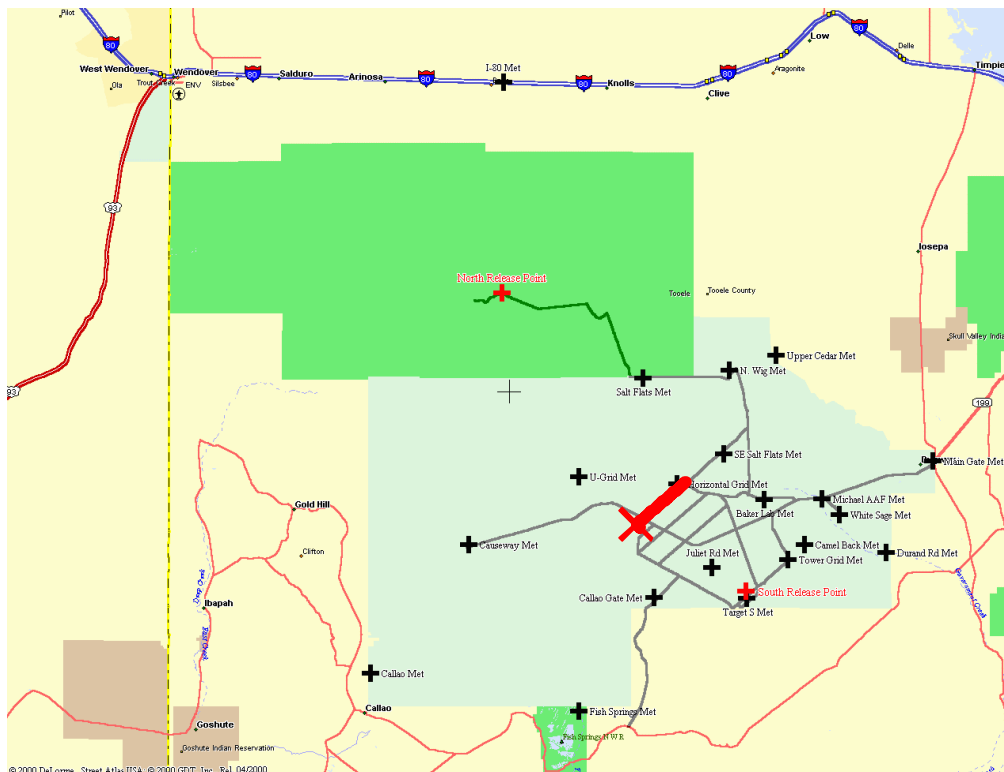
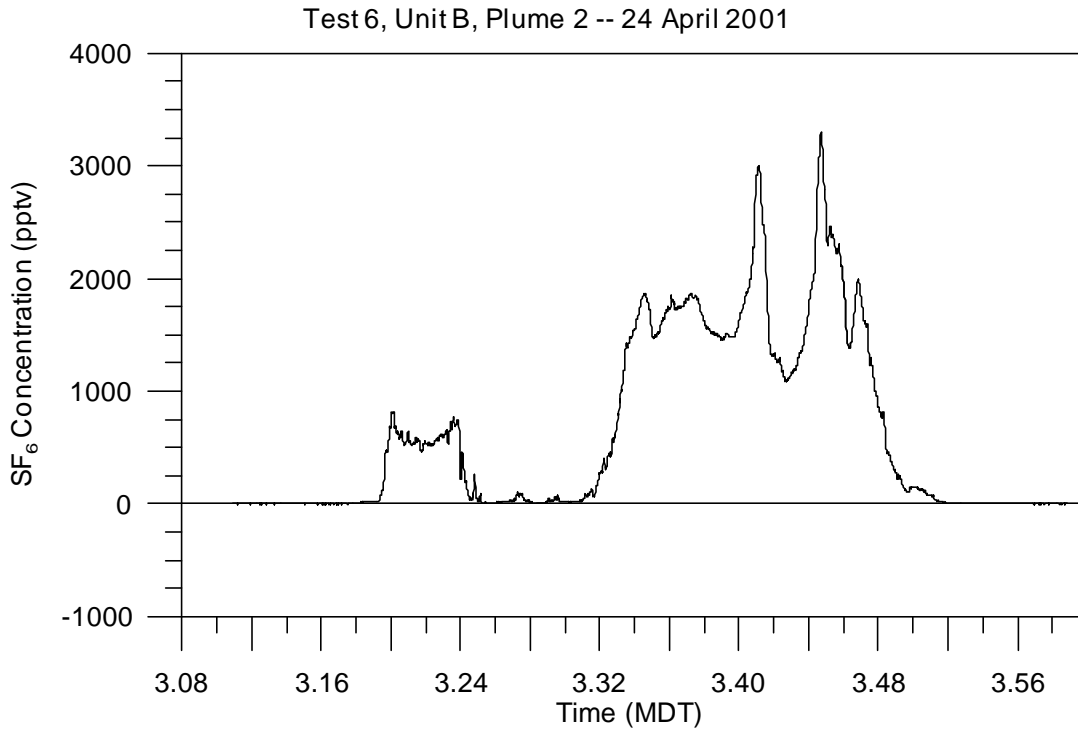


Figure A-217. SF₆ concentration of Plume 2 for Sampling Unit B during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

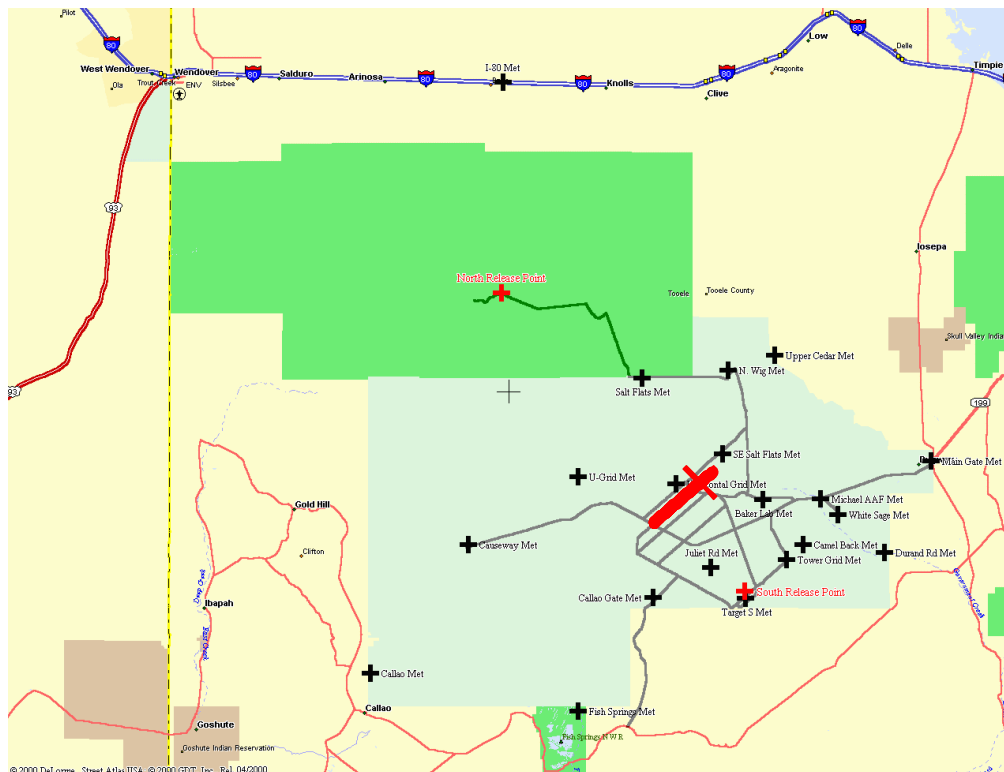
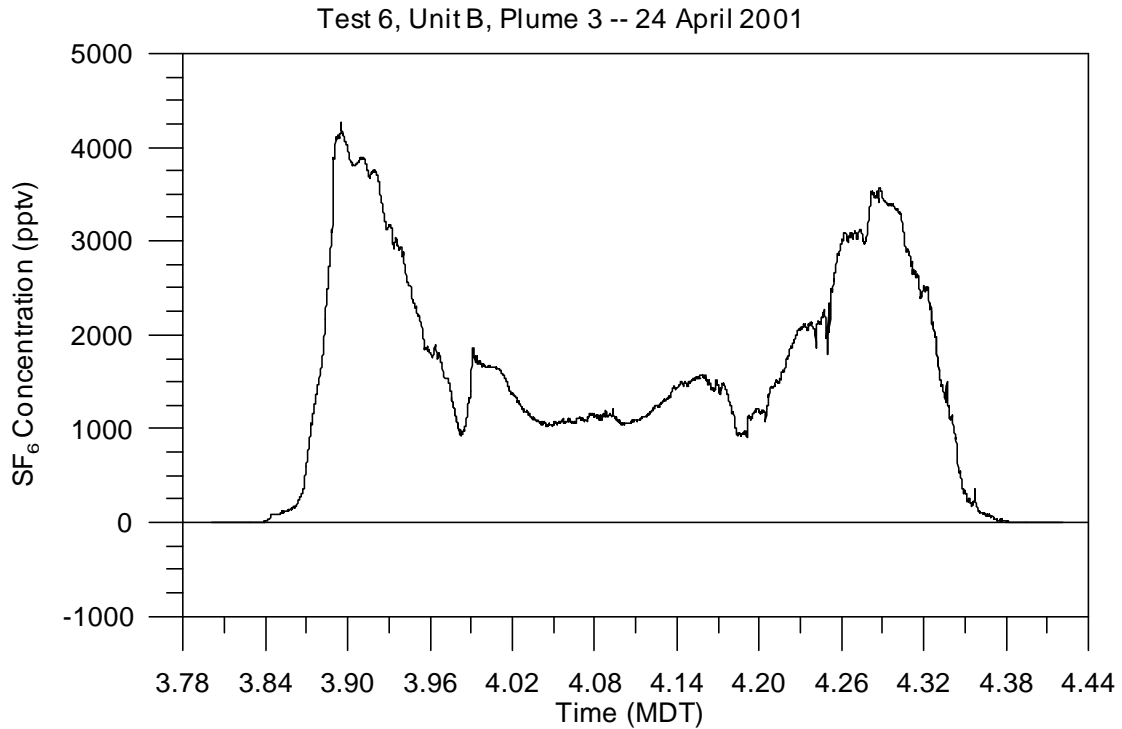


Figure A-218. SF₆ concentration of Plume 3 for Sampling Unit B during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

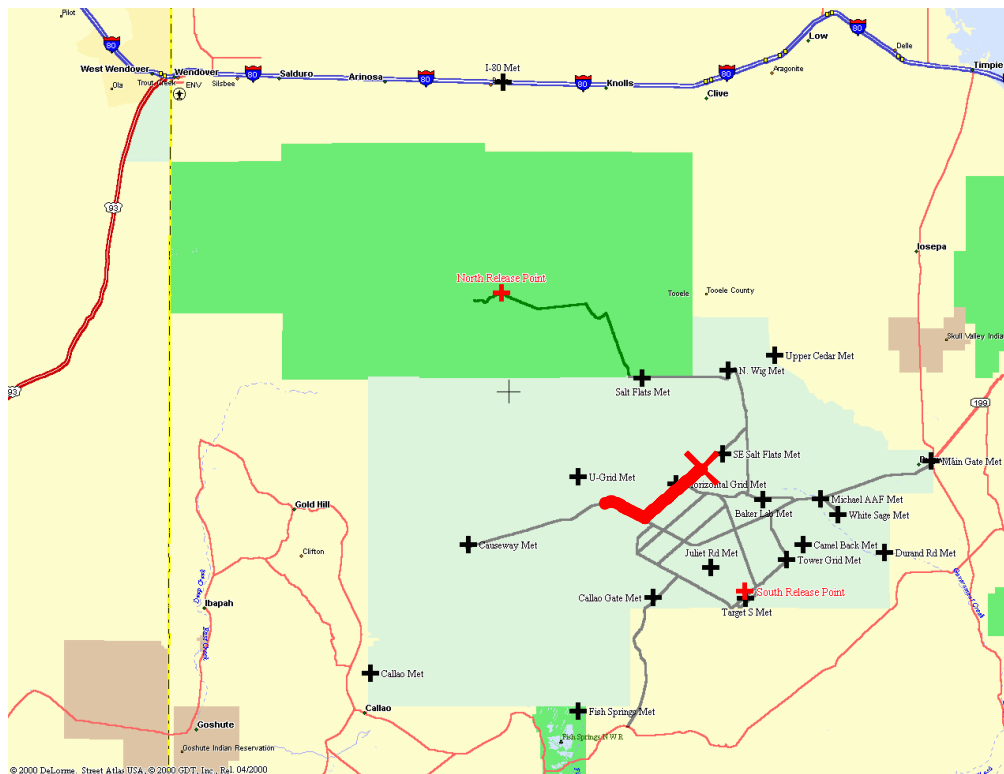
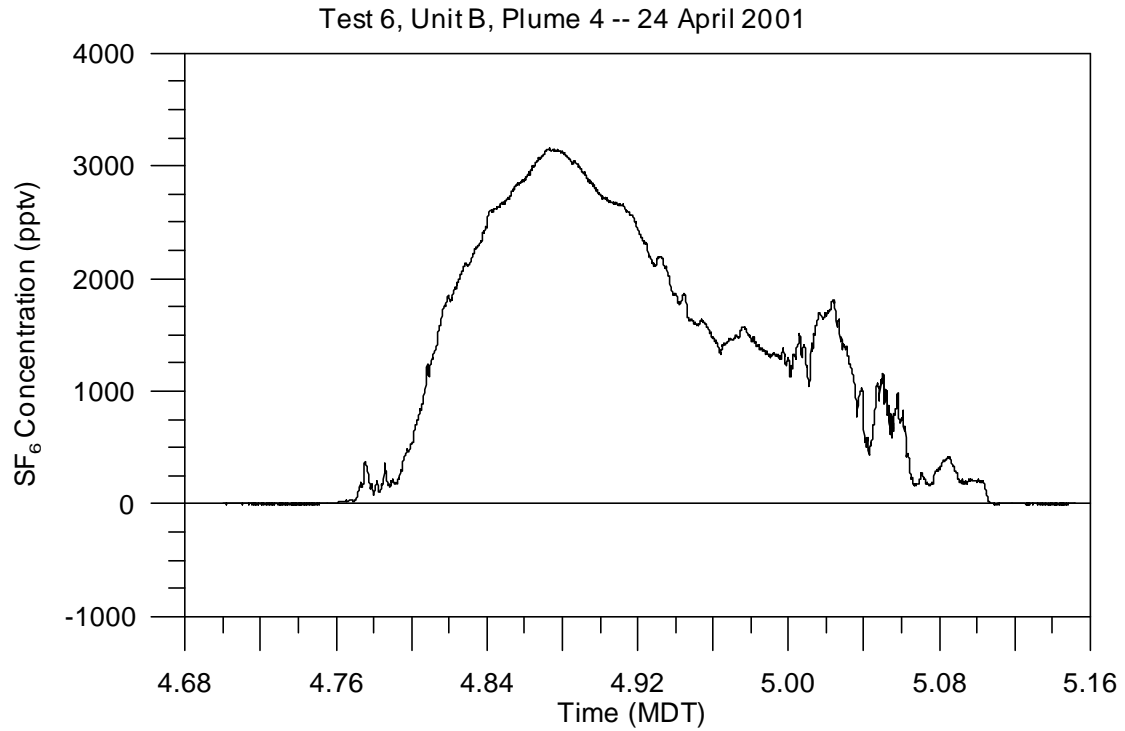


Figure A-219. SF₆ concentration of Plume 4 for Sampling Unit B during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

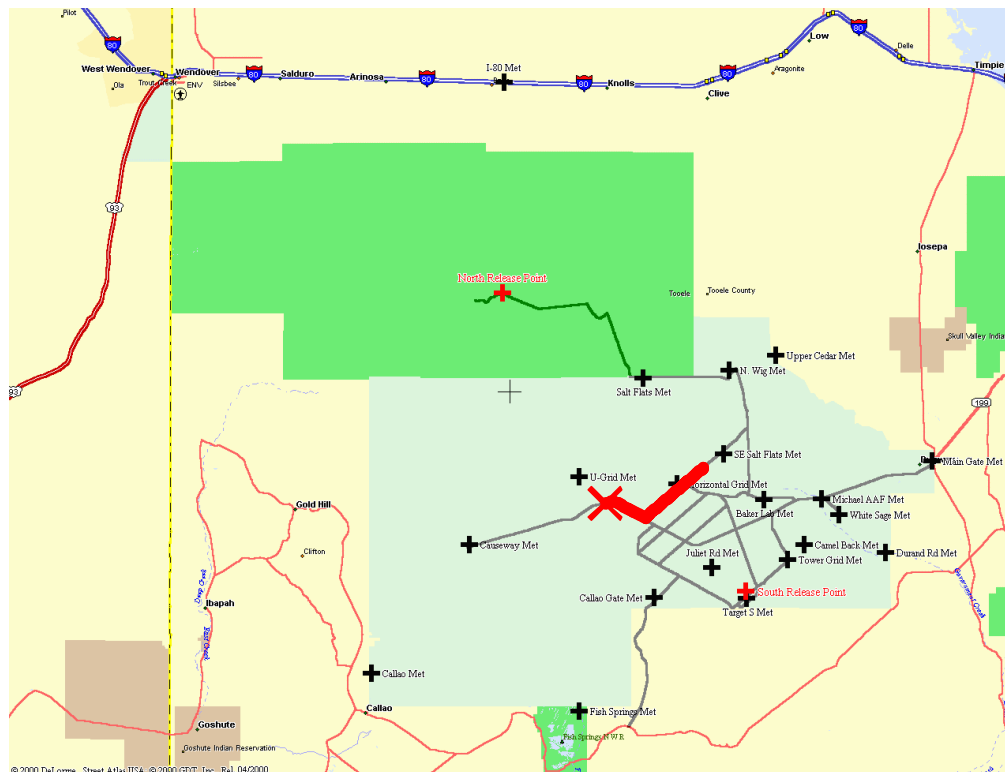
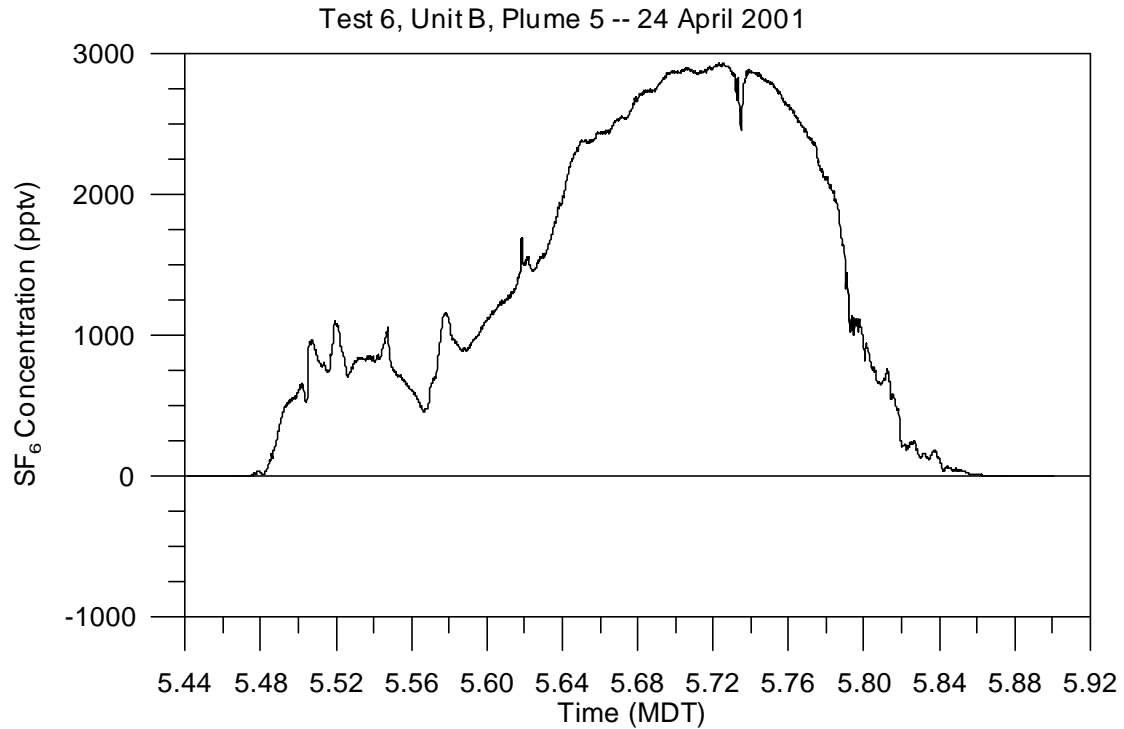


Figure A-220. SF₆ concentration of Plume 5 for Sampling Unit B during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

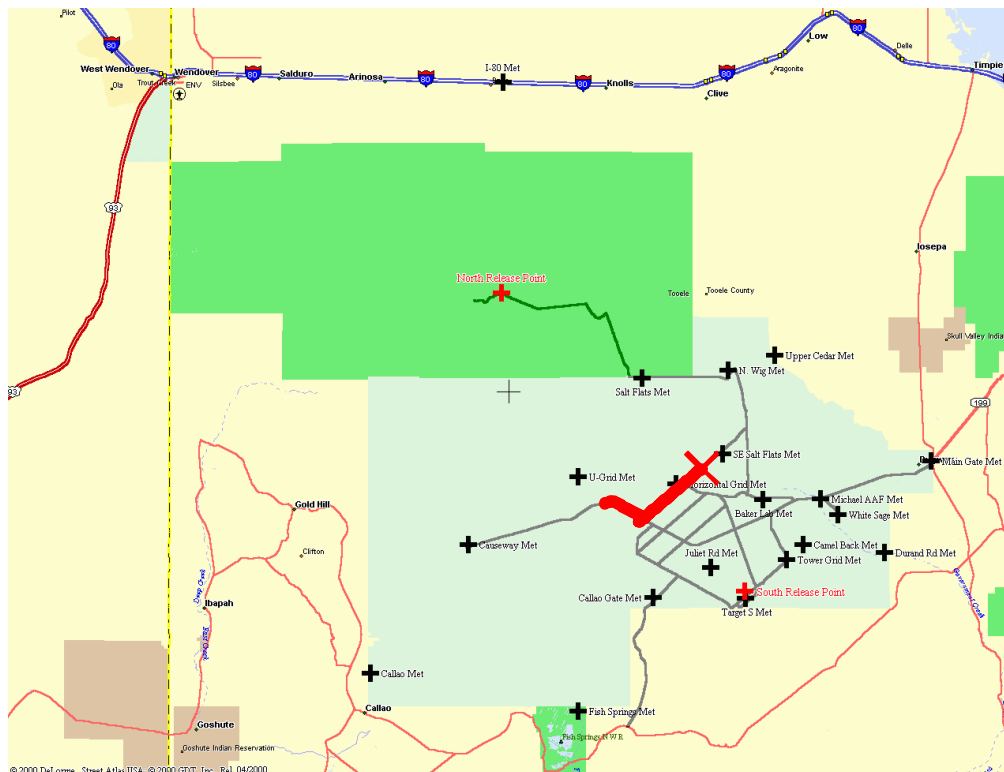
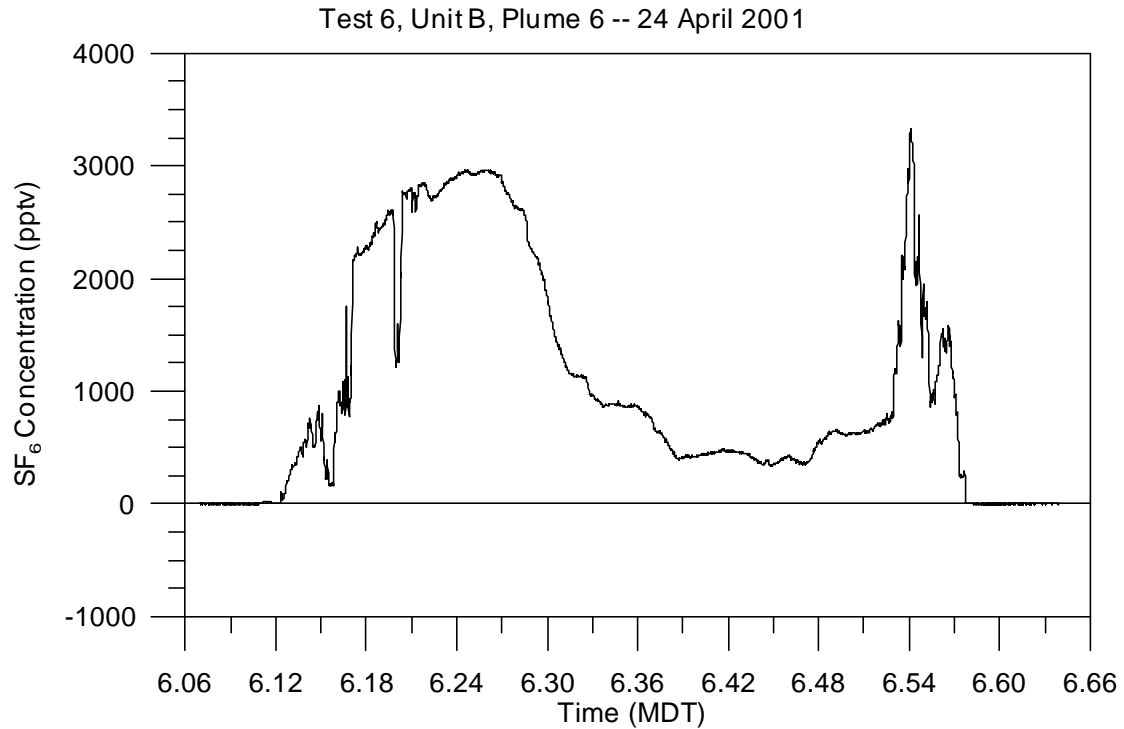


Figure A-221. SF₆ concentration of Plume 6 for Sampling Unit B during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

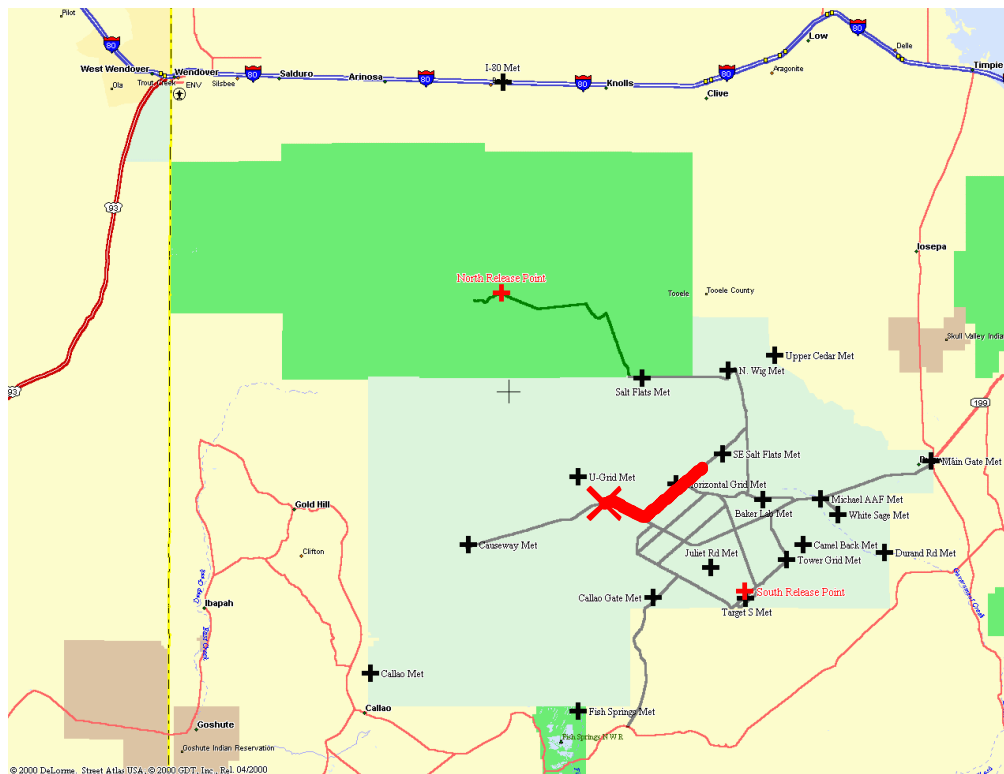
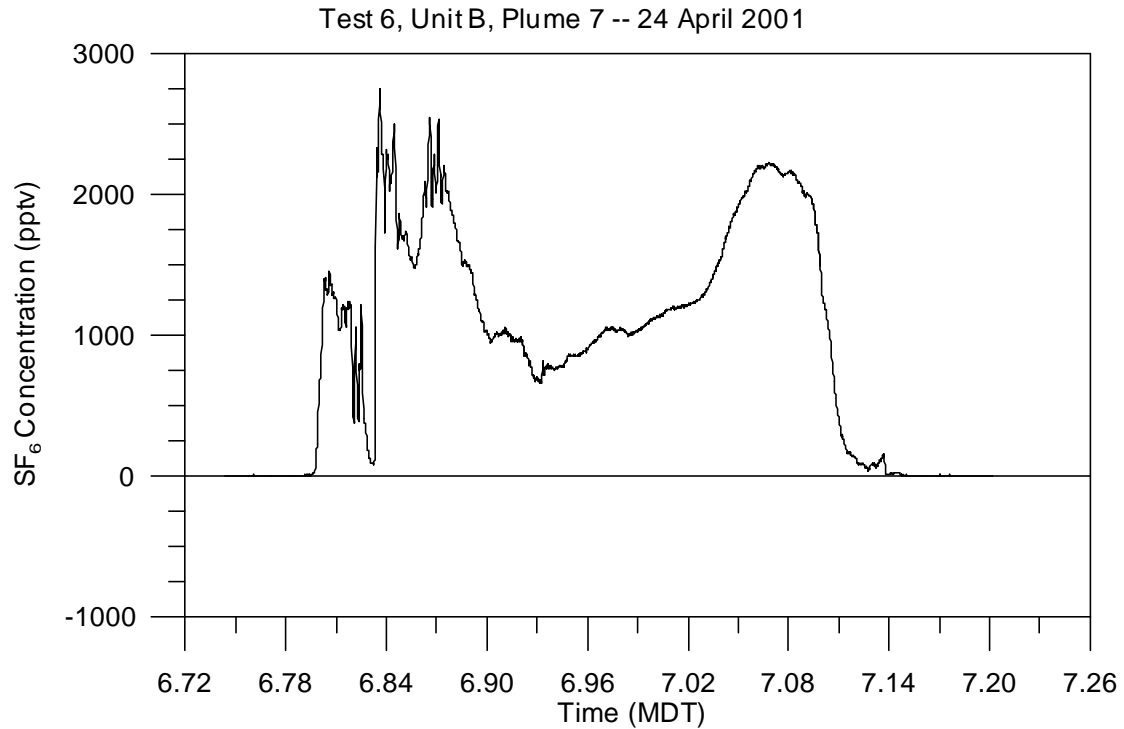


Figure A-222. SF₆ concentration of Plume 7 for Sampling Unit B during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

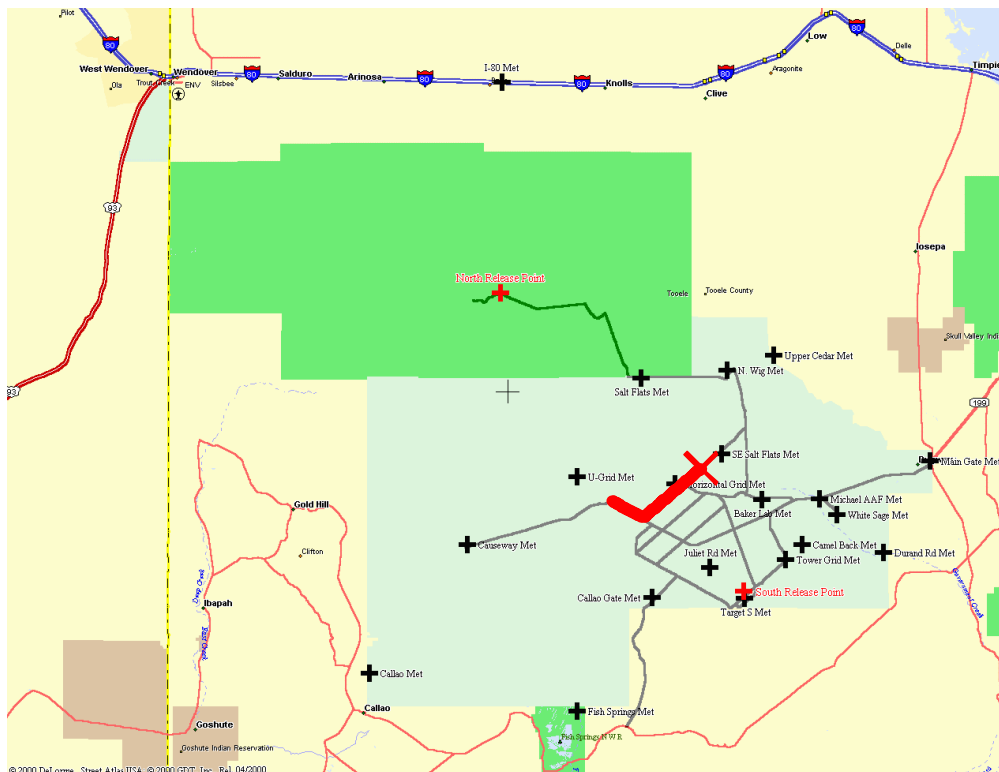
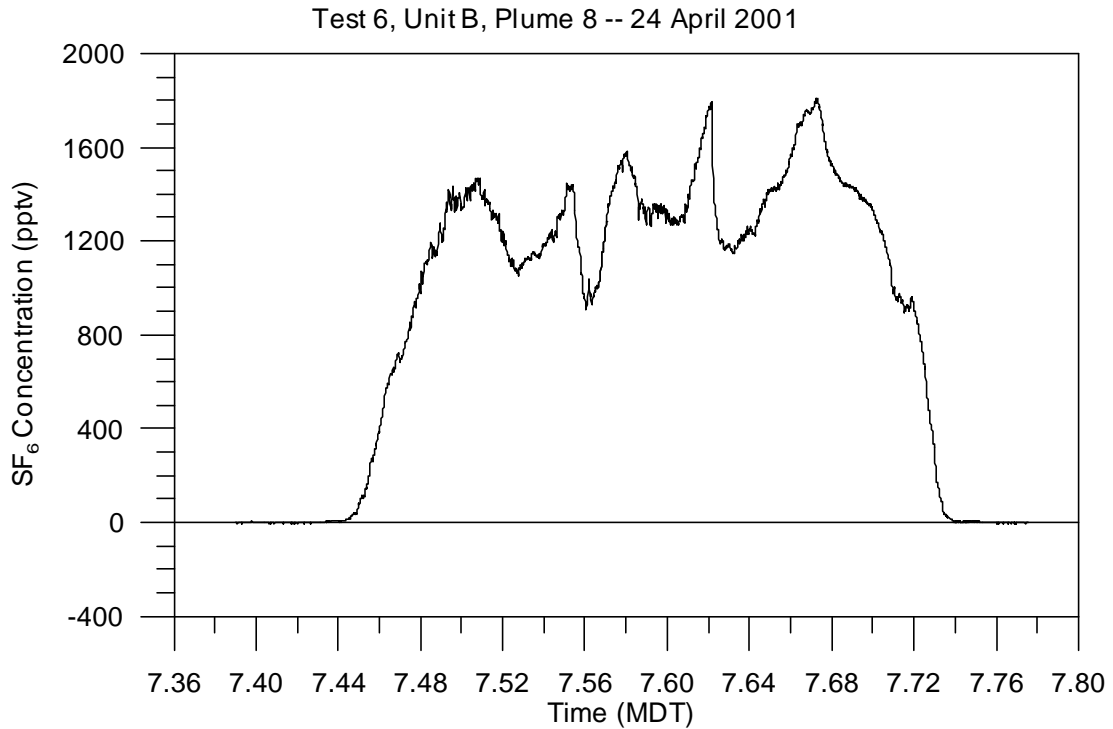


Figure A-223. SF₆ concentration of Plume 8 for Sampling Unit B during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

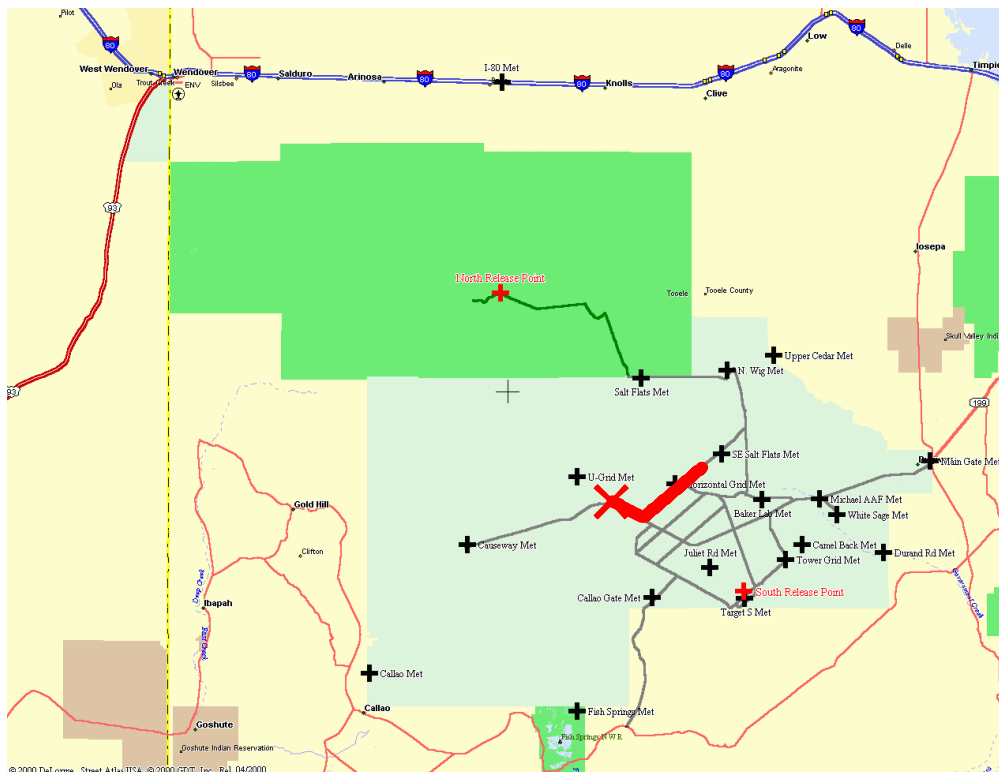
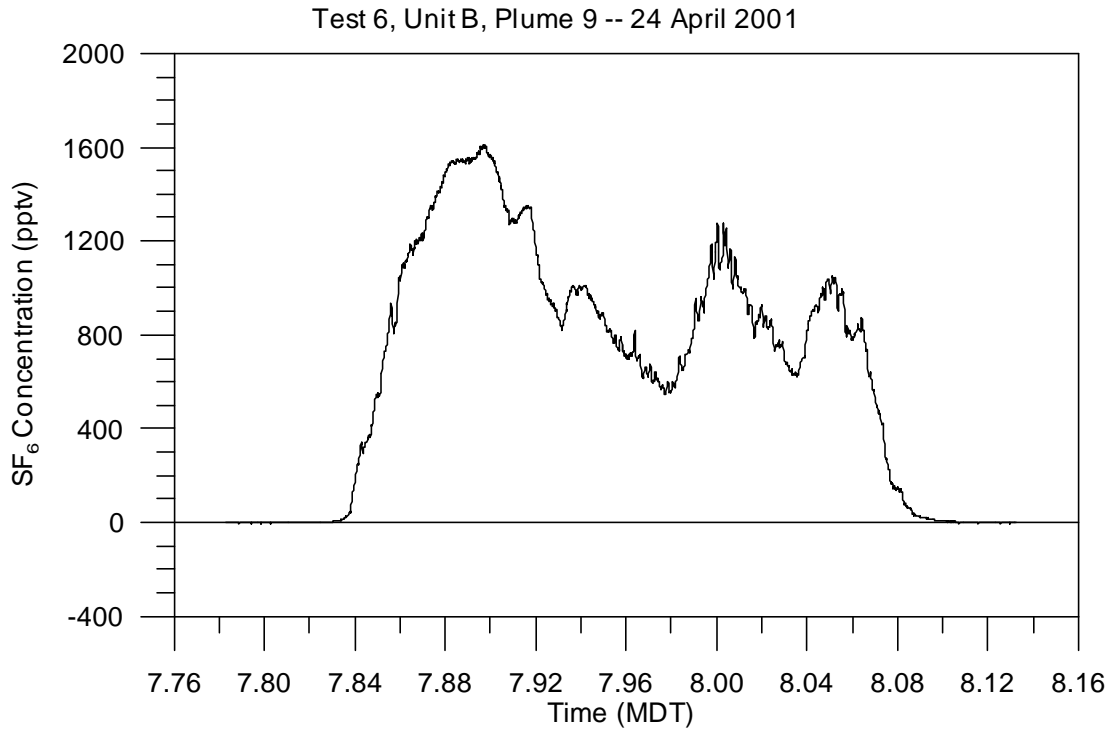


Figure A-224. SF₆ concentration of Plume 9 for Sampling Unit B during Test 6 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 6
Sampling Unit C

Sampling Unit C was not used during Test 6, as instructed by the AFTAC controller.

Test 7 Sampling Unit A

Table A-58. Test 7 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	2:16	2:30
2	2:34	2:49
3	2:53	3:05
4	3:11	3:22

Table A-59. Summary of individual SF₆ plume characteristics measured by Sampling Unit A during Test 7. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	3:33-3:41	1041	305.1-317.4	17.87	18.10	18.43
2	3:42-3:45	421	304.7-305.1	18.43	18.66	19.51
3	3:48-4:02	1721	304.5-319.6	17.87	18.53	20.18
4	4:18-4:37	2241	302.5-325.9	17.86	20.10	24.06
5	4:46-5:05	2301	301.7-330.8	17.87	19.44	24.39
6	5:12-5:36	2919	296.9-330.8	17.86	20.42	26.44
7	6:11-6:13	301	293.9-299.5	25.67	26.46	27.23
8	6:14-6:46	3841	299.6-357.4	17.87	19.74	25.63
9	7:06-7:40	4160	293.5-354.8	17.87	21.00	27.39
10	7:48-8:24	4341	293.8-359.8	17.87	20.27	27.27
11	8:47-9:18	3777	303.7-349.1	17.87	18.72	23.21
12	9:26-9:48	2683	303.8-339.4	17.87	18.57	22.92
13	10:13-10:20	861	0.9-27.4	13.83	14.36	15.33

Table A-60. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit A during Test 7.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	459.7	3:37	40.164787	113.211760	310.7	18.07
2	1168.7	3:44	40.154202	113.227848	305.1	18.43
3	5049.1	3:53	40.155443	113.226027	305.8	18.39
4	3564.2	4:30	40.164000	113.251883	304.3	20.74
5	3139.1	4:49	40.168730	113.263532	304.0	21.86
6	3052.9	5:28	40.167902	113.261508	304.0	21.66
7	213.2	6:12	40.165060	113.330023	296.4	26.57
8	2518.5	6:33	40.189532	113.174187	324.1	17.92
9	5318.6*	7:17	40.186308	113.179112	322.4	17.89
10	5297.5*	8:12	40.199152	113.159660	329.3	18.14
11	9011.0	8:51	40.207257	113.147228	333.6	18.42
12	2121.8	9:42	40.188648	113.175553	323.7	17.91
13	19.7	10:15	40.184365	113.039328	4.1	13.99

*Analyzer over-ranged during this traverse, resulting in a flat-topped peak and an unknown maximum concentration.

Table A-61. Test 7 Sampling Unit A sampling traverses yielding no detectable SF₆ (null pass) during active SF₆ plume encounters.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
5	5:47	5:56

No null passes were made by Sampling Unit A after the time period of active plume sampling listed in the previous Tables 59 and 60.

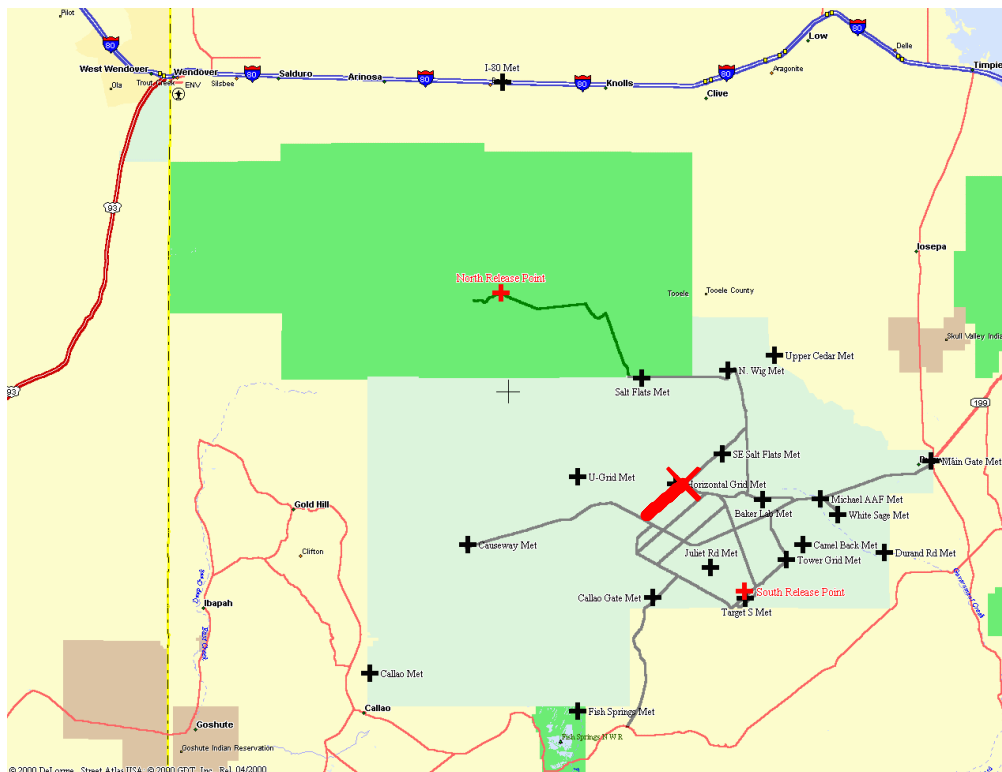
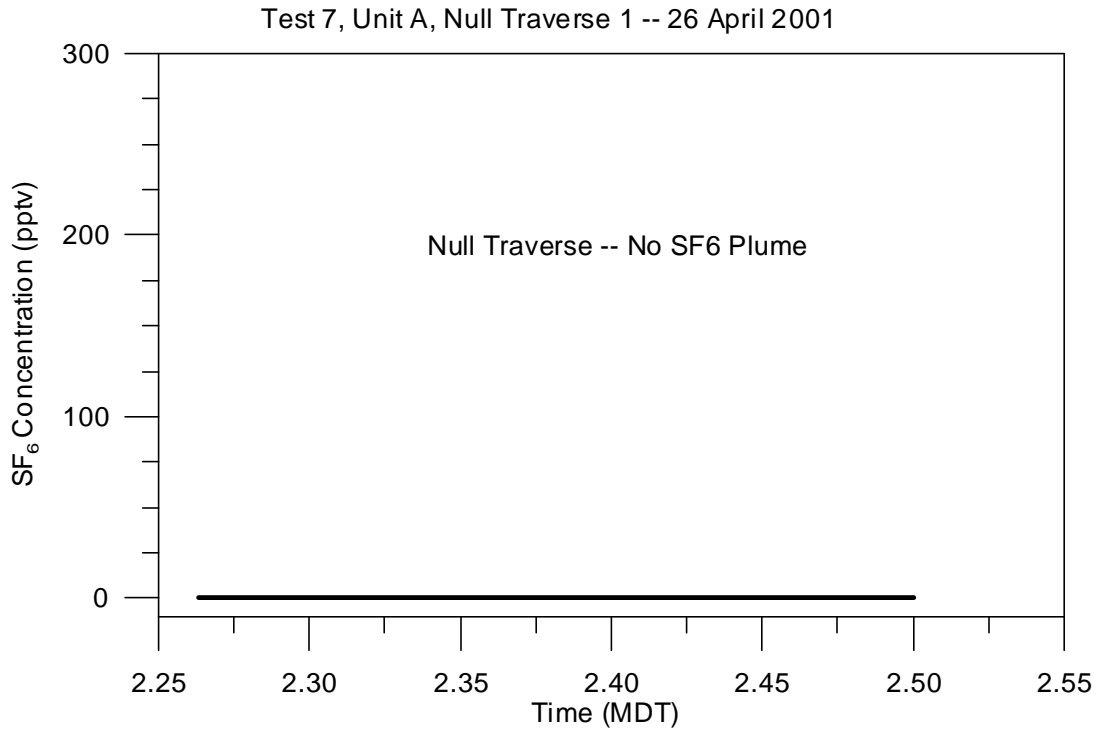


Figure A-225. Null sampling traverse 1 made by Sampling Unit A during Test 7, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

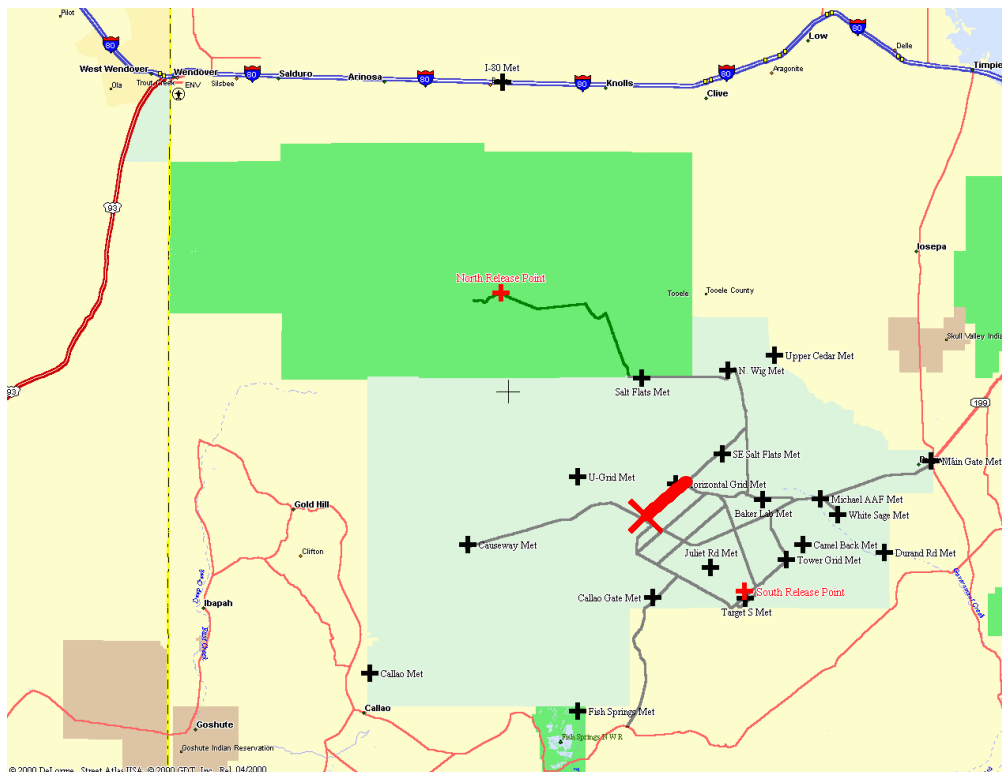
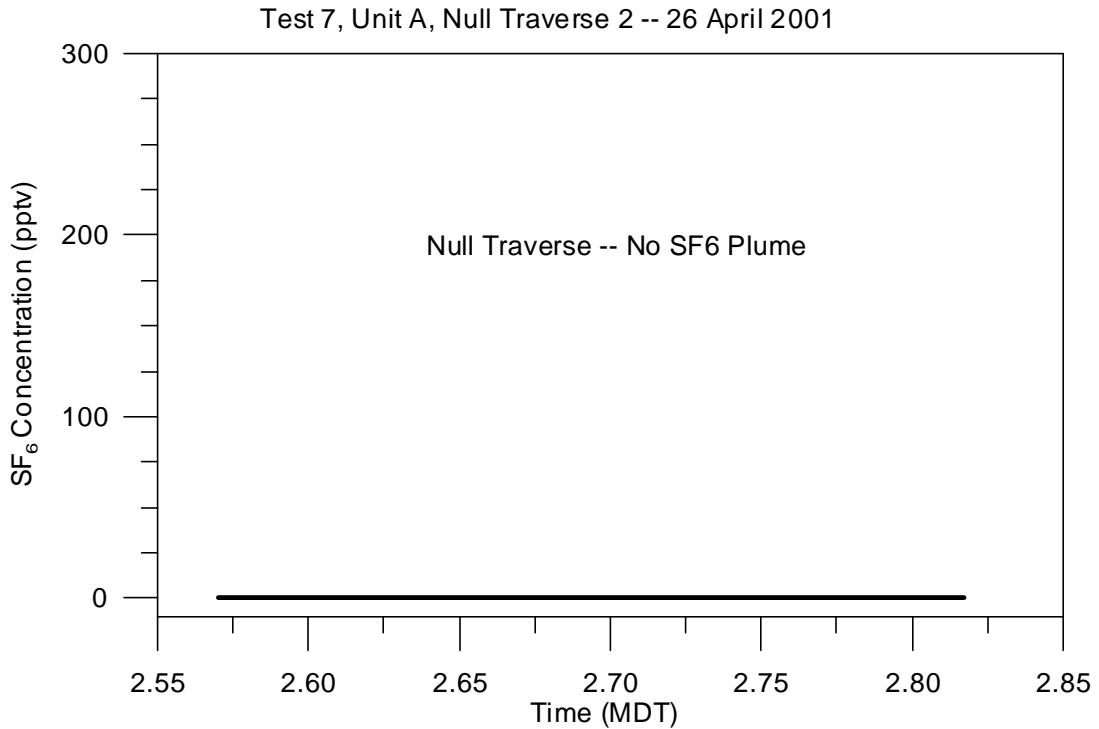


Figure A-226. Null sampling traverse 2 made by Sampling Unit A during Test 7, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

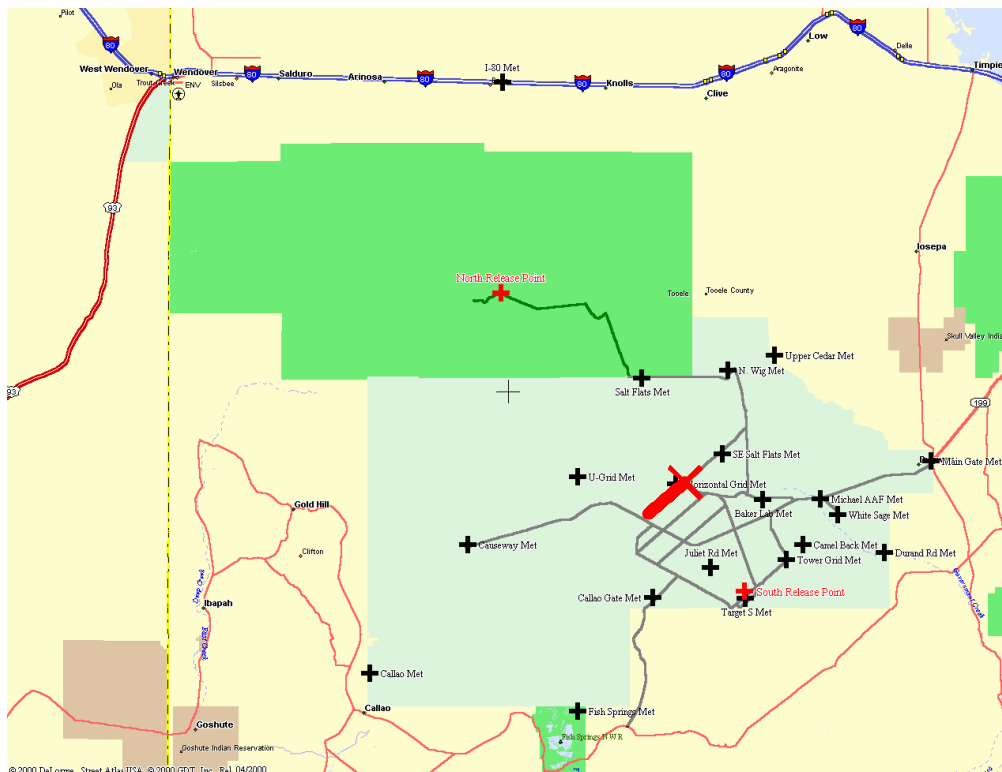
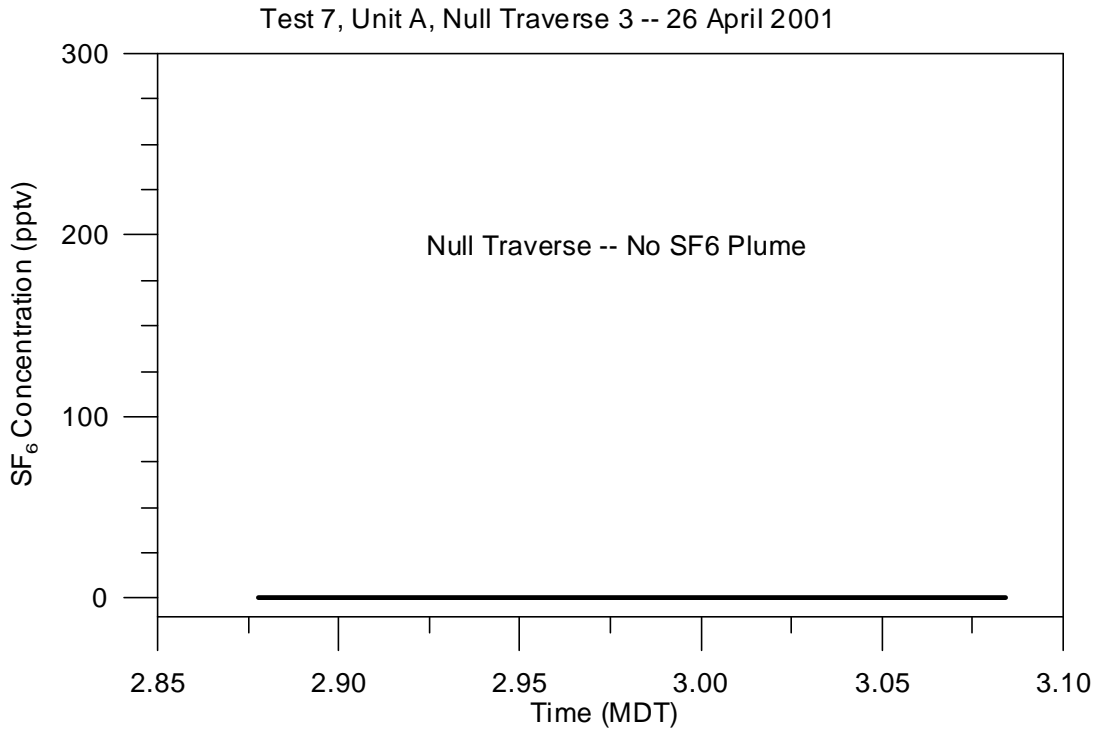


Figure A-227. Null sampling traverse 3 made by Sampling Unit A during Test 7, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

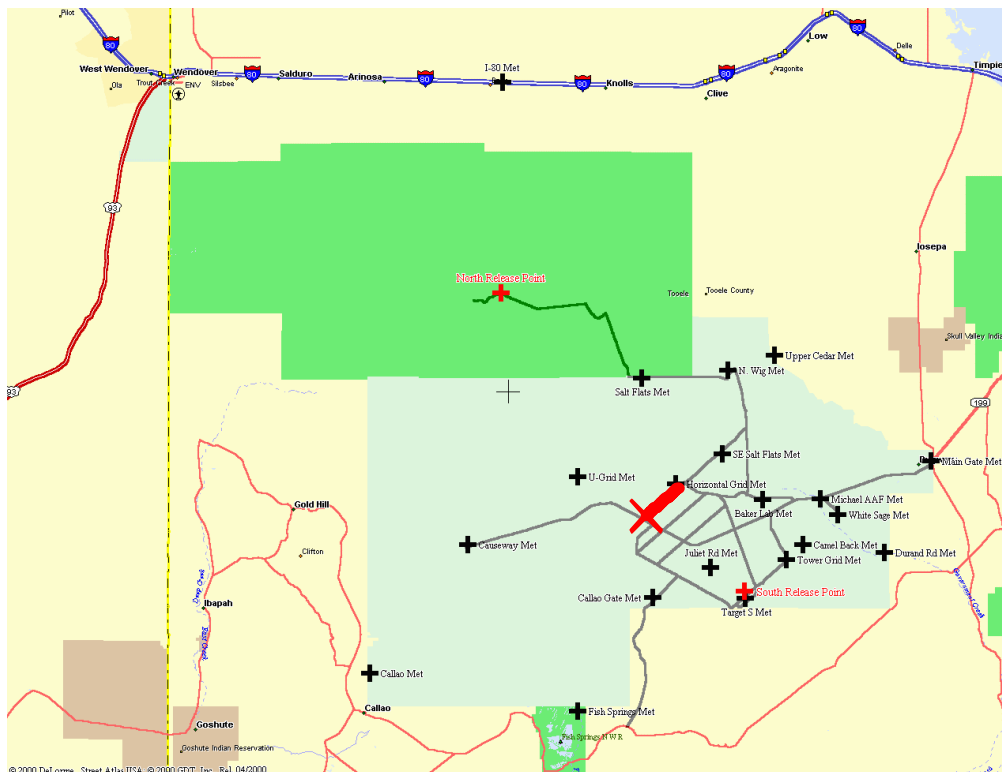
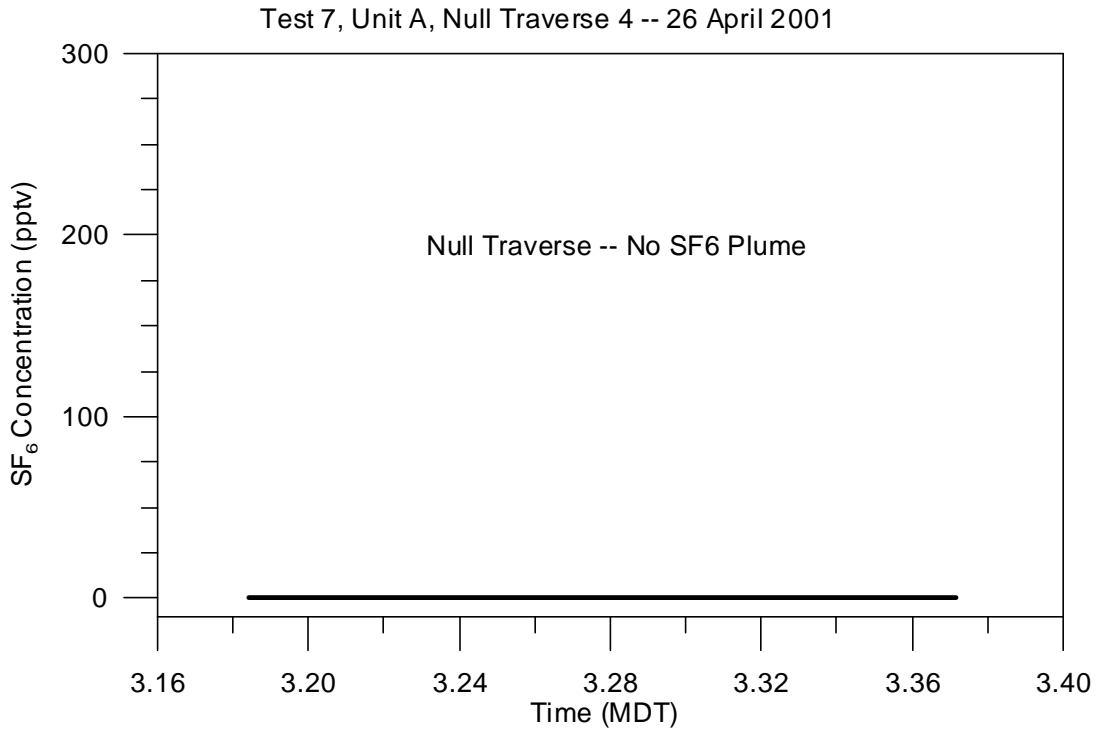


Figure A-228. Null sampling traverse 4 made by Sampling Unit A during Test 7, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

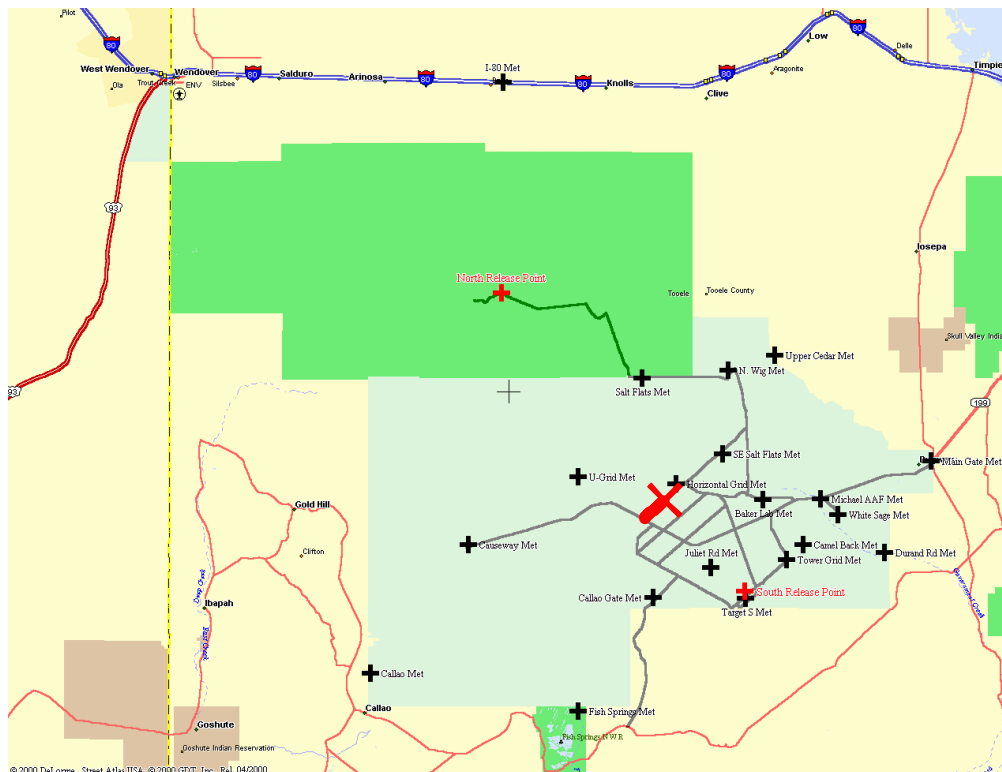
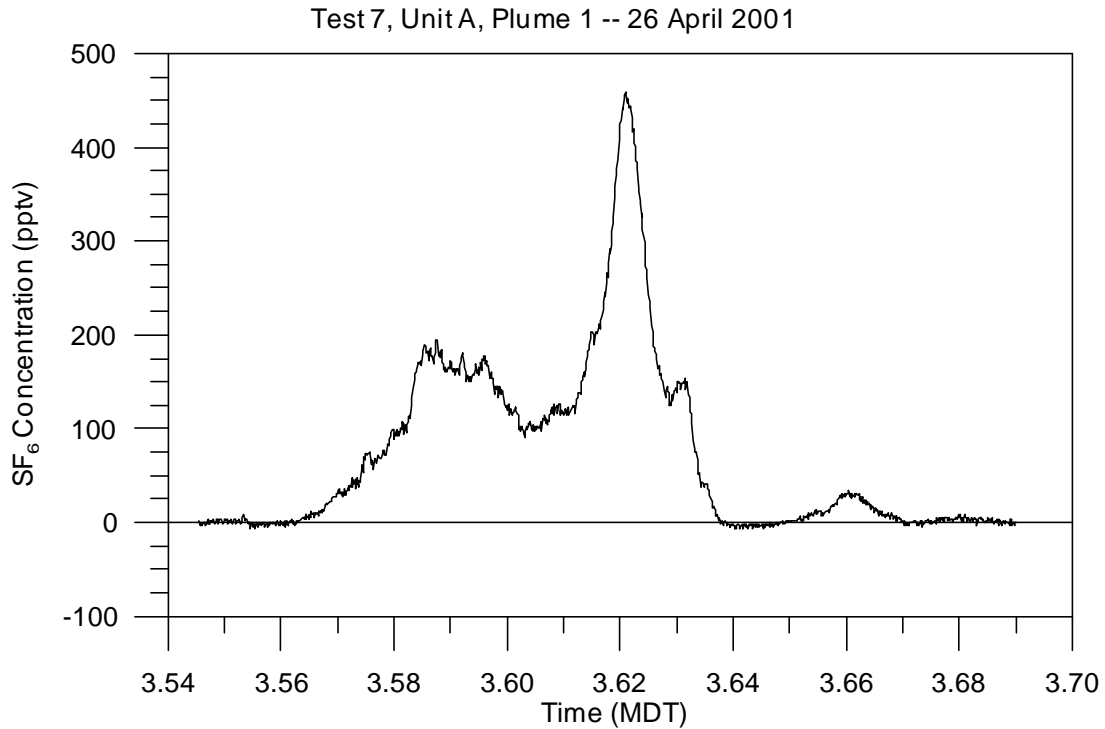


Figure A-229. SF₆ concentration of Plume 1 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

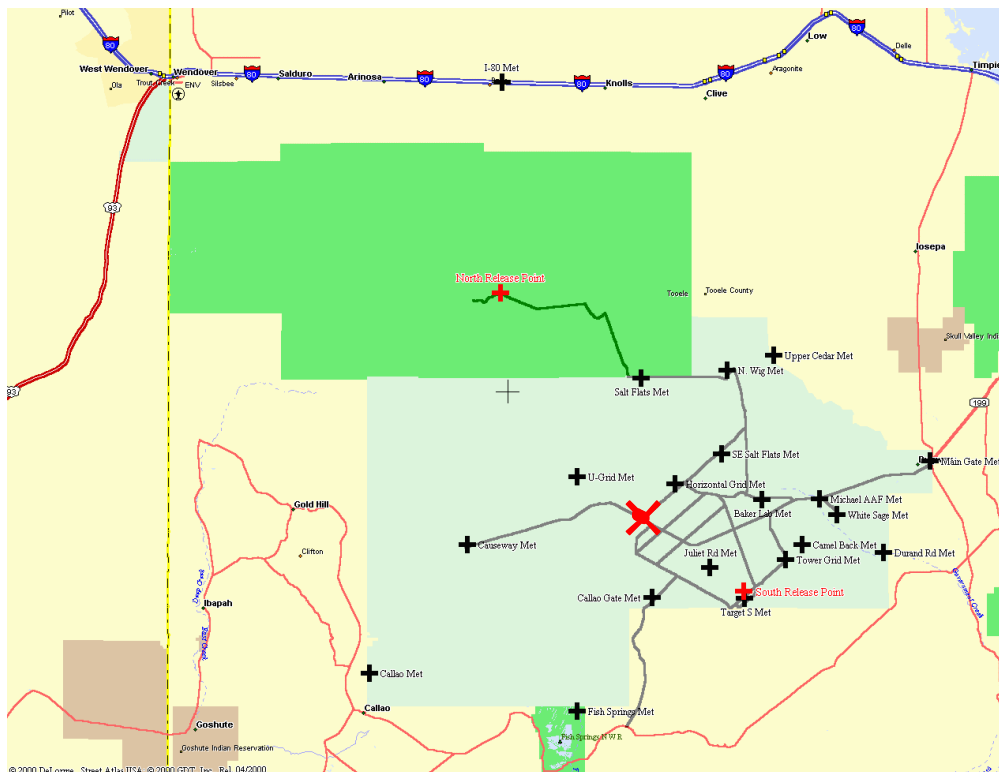
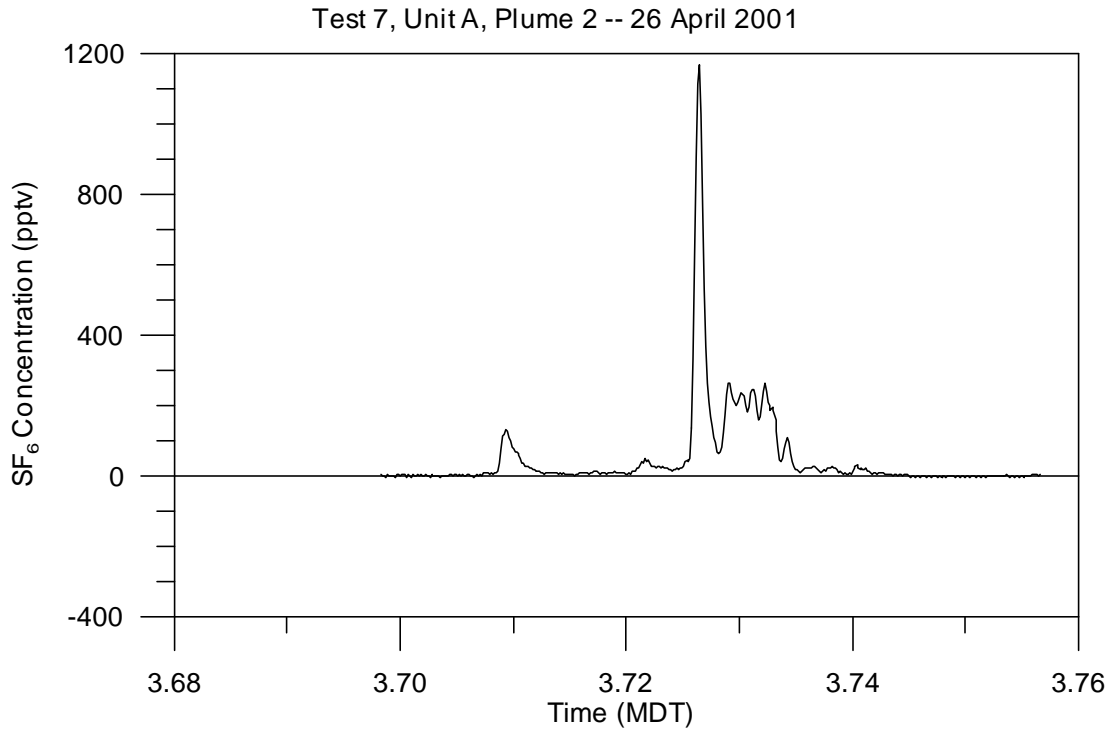


Figure A-230. SF₆ concentration of Plume 2 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

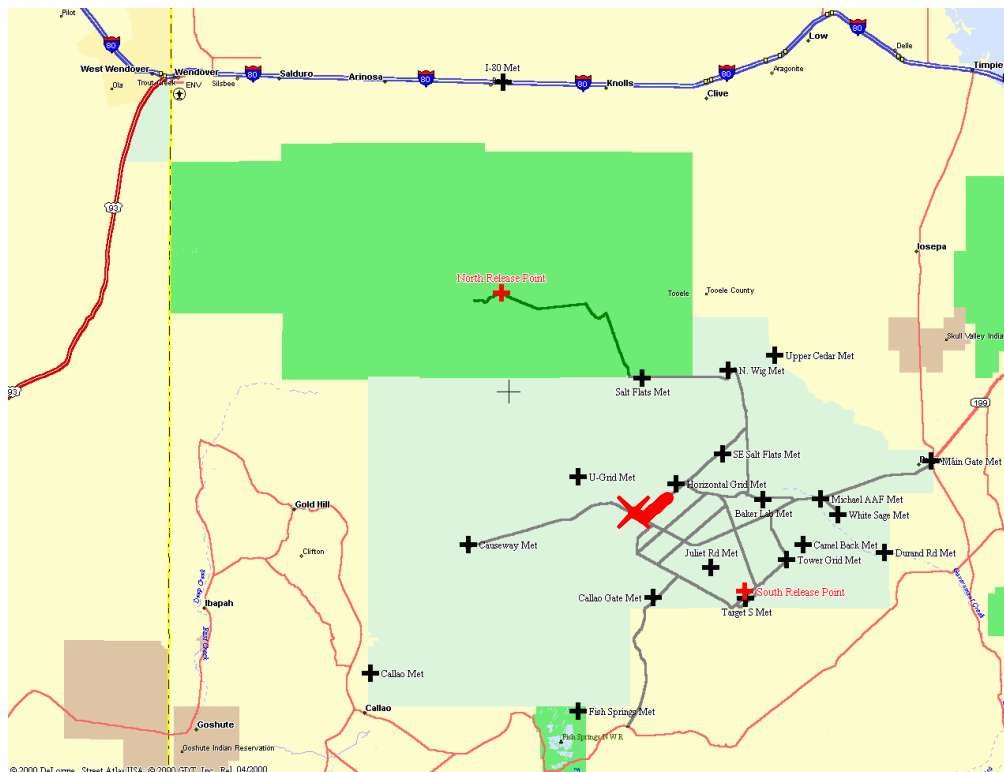
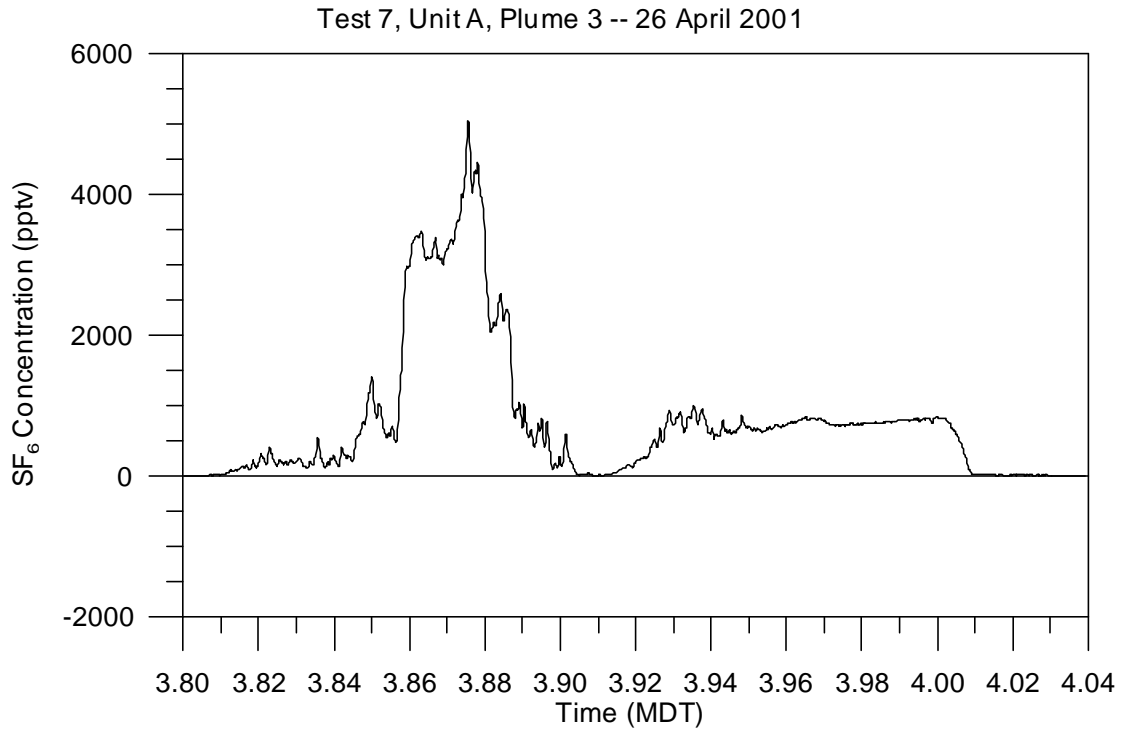


Figure A-231. SF₆ concentration of Plume 3 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

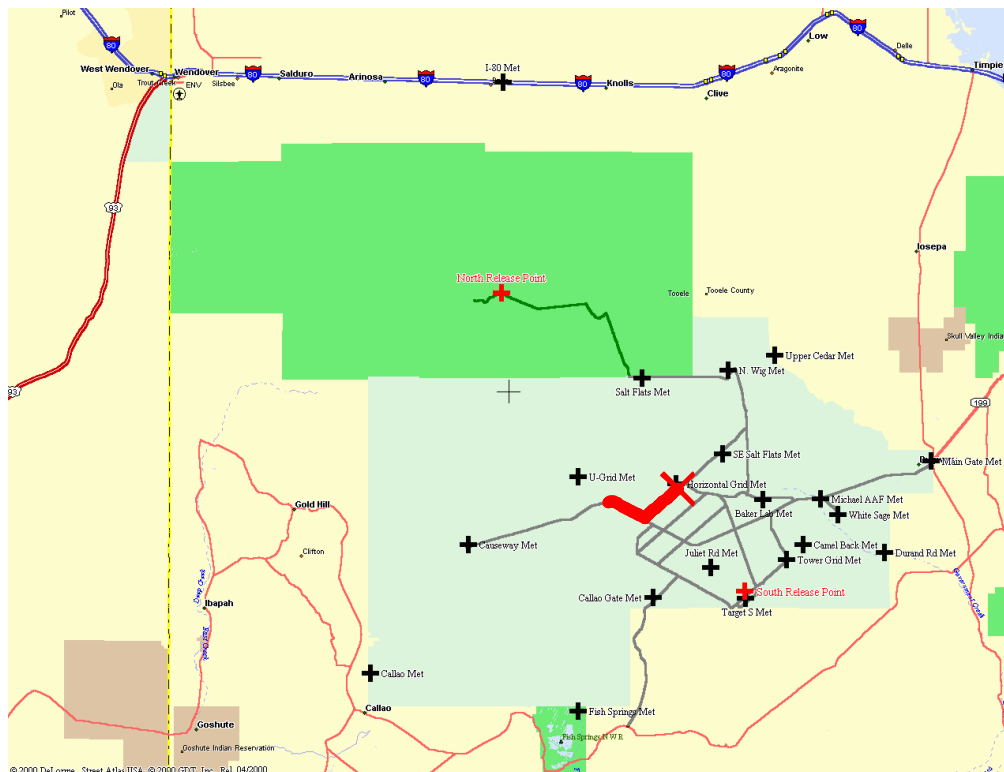
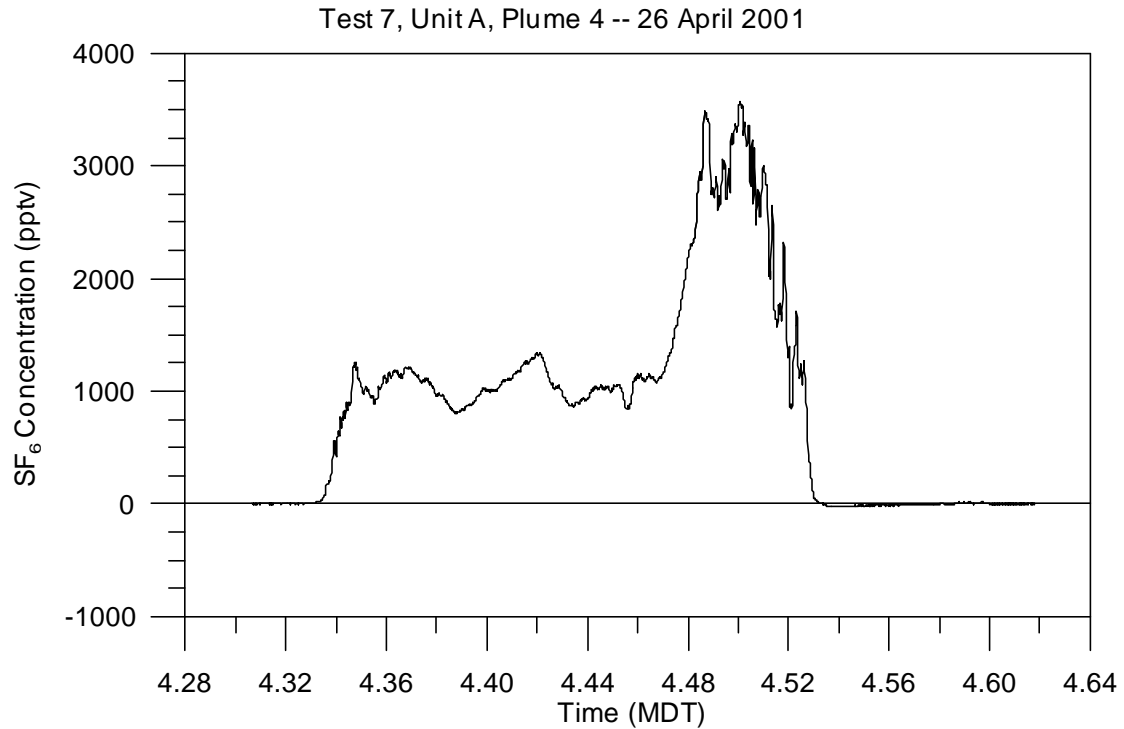


Figure A-232. SF₆ concentration of Plume 4 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

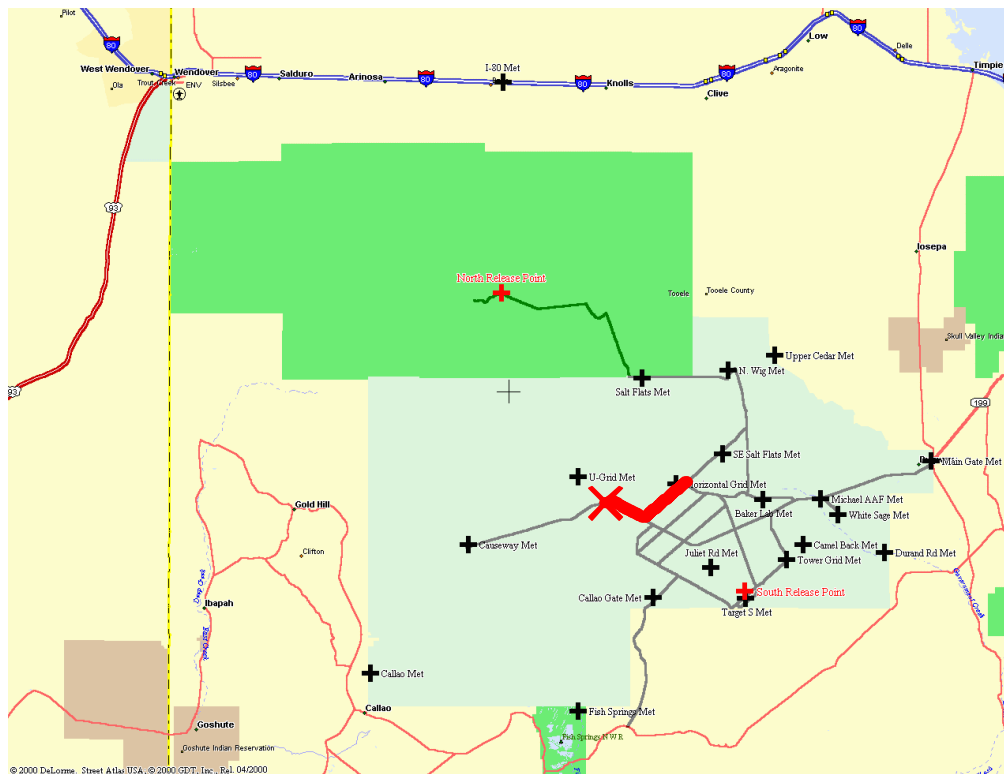
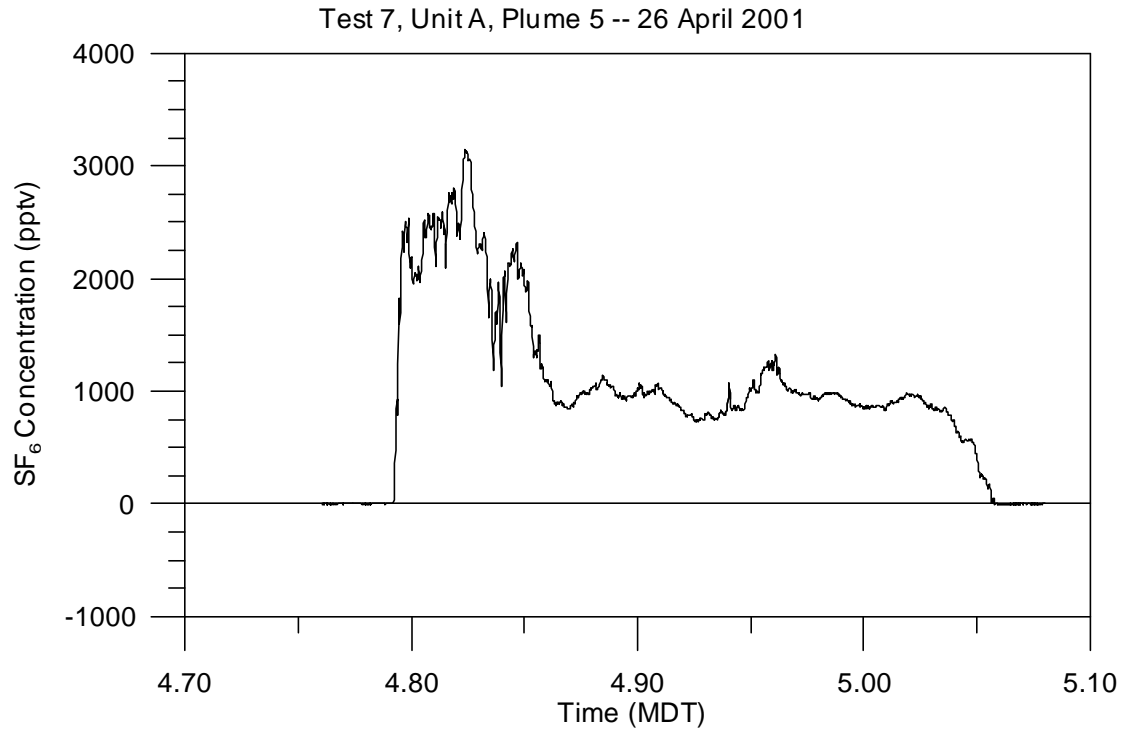


Figure A-233. SF₆ concentration of Plume 5 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

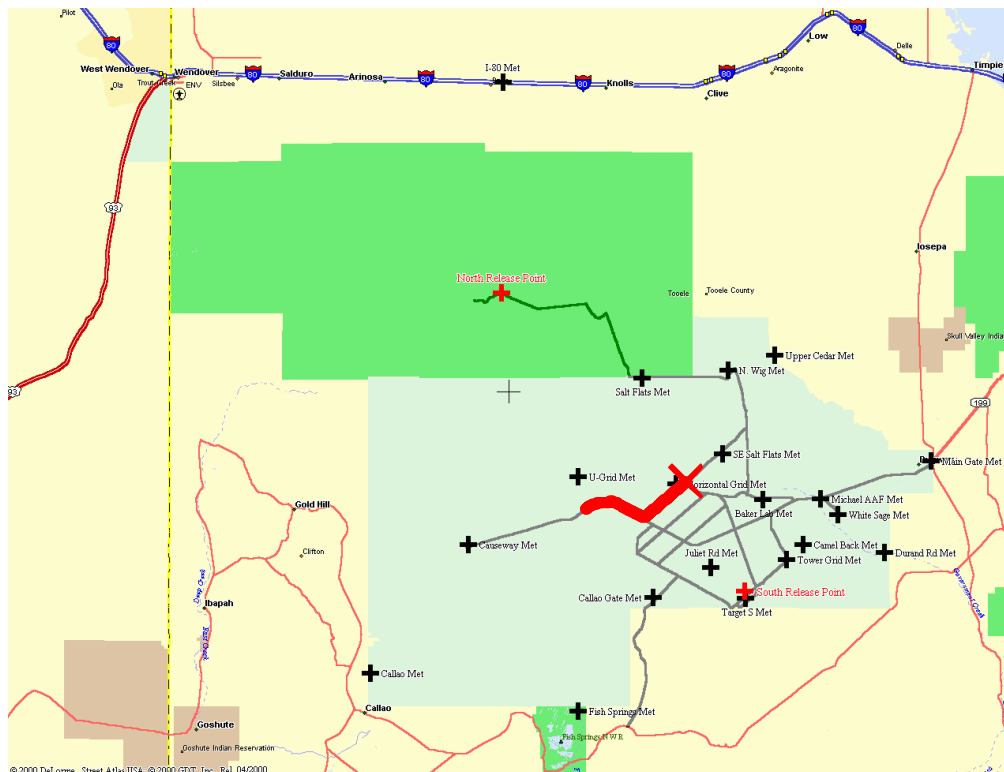
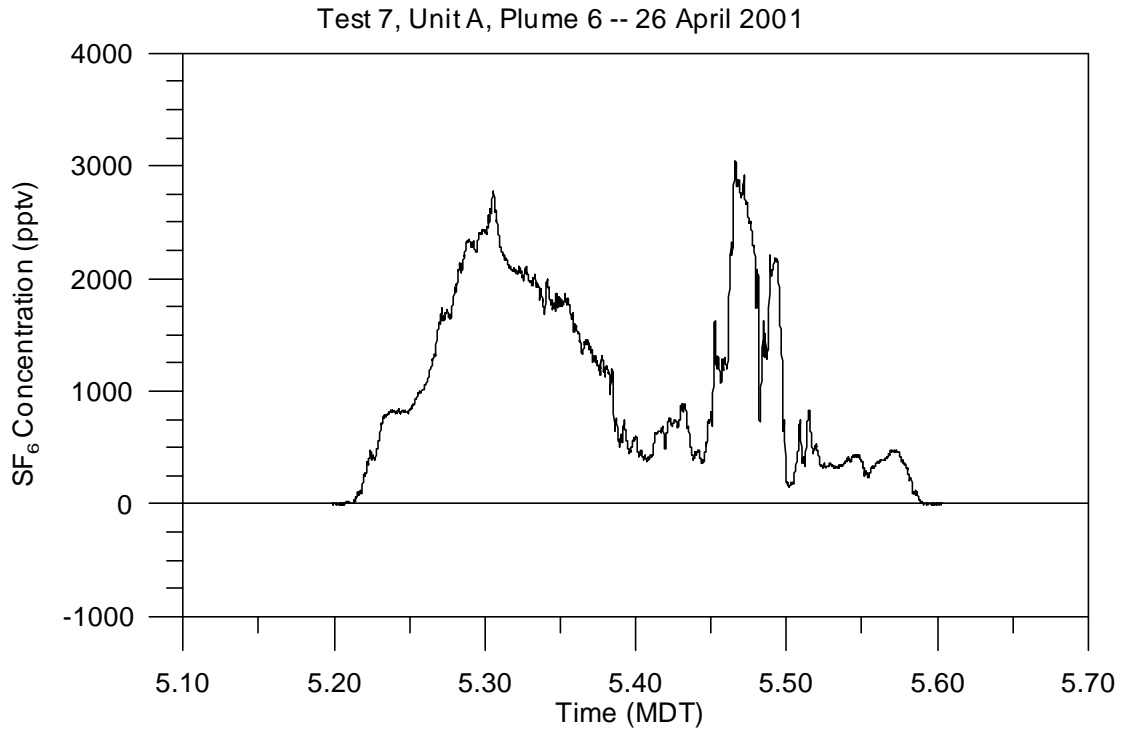


Figure A-234. SF₆ concentration of Plume 6 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

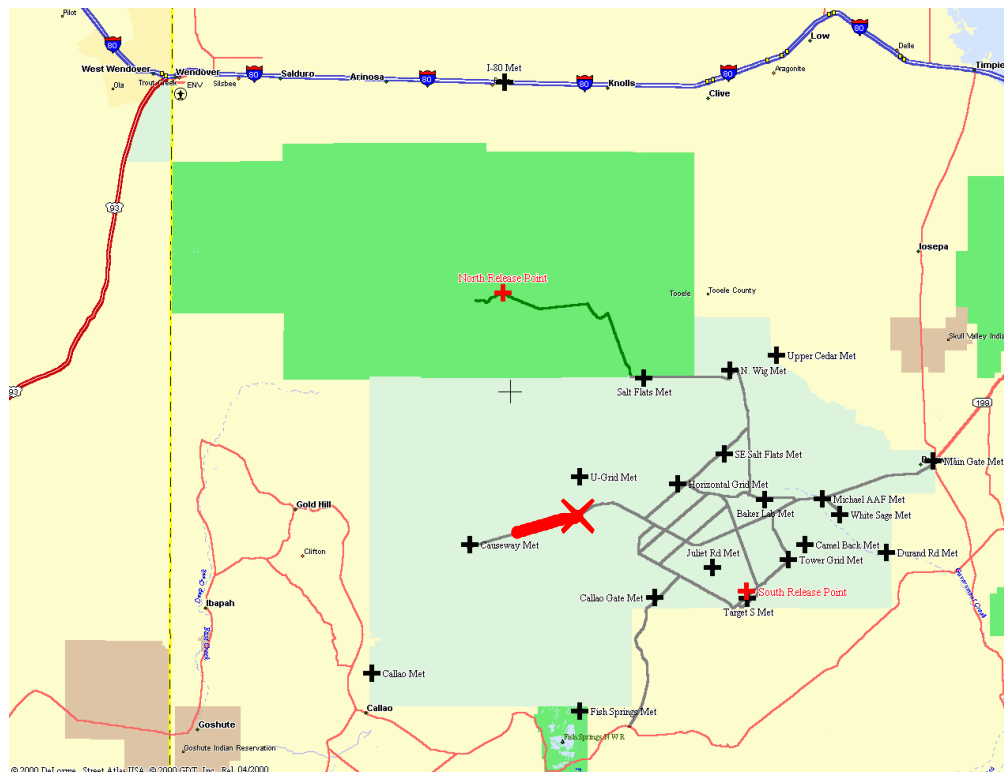
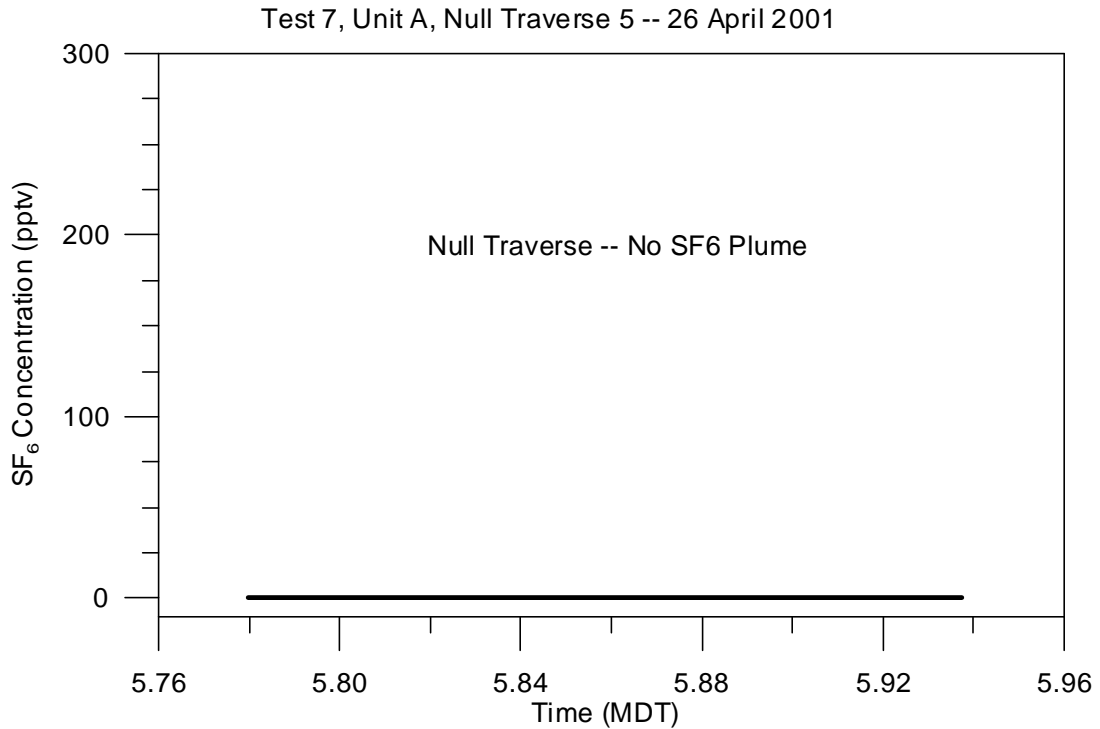


Figure A-235. Null sampling traverse 5 made by Sampling Unit A during Test 7, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

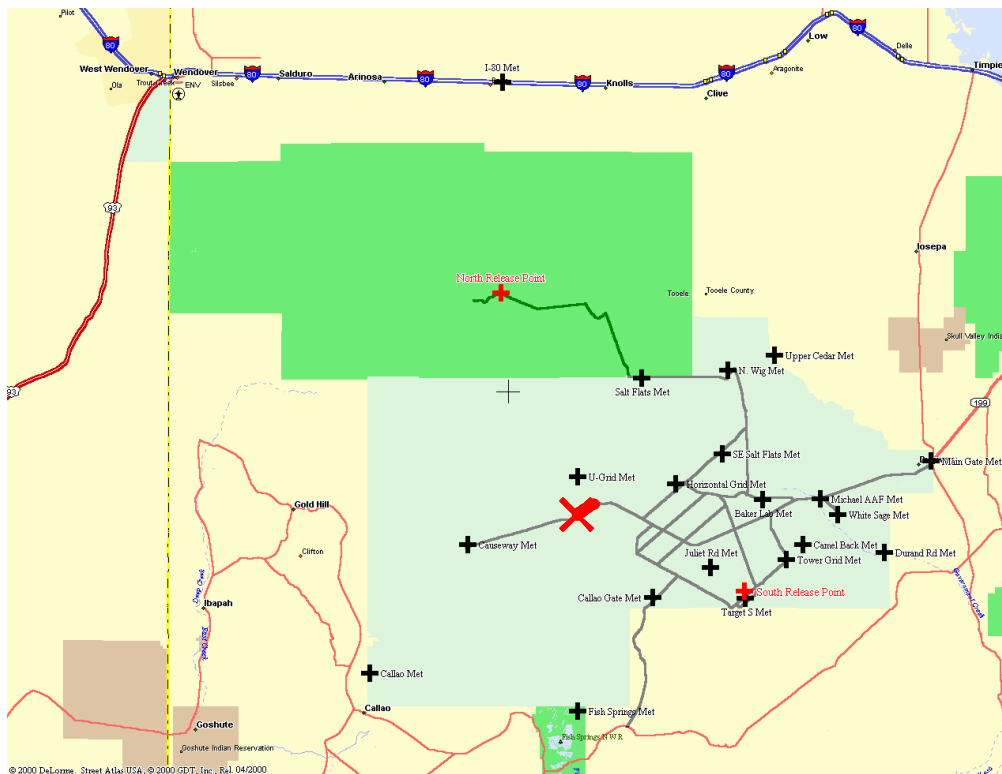
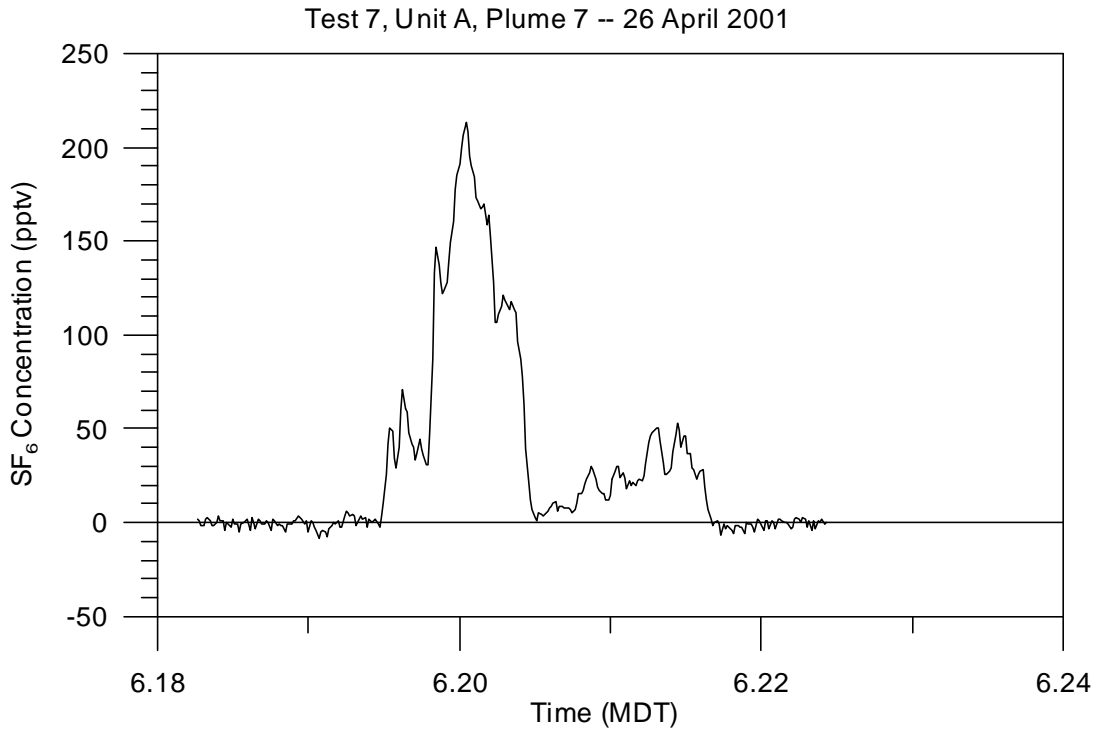


Figure A-236. SF₆ concentration of Plume 7 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

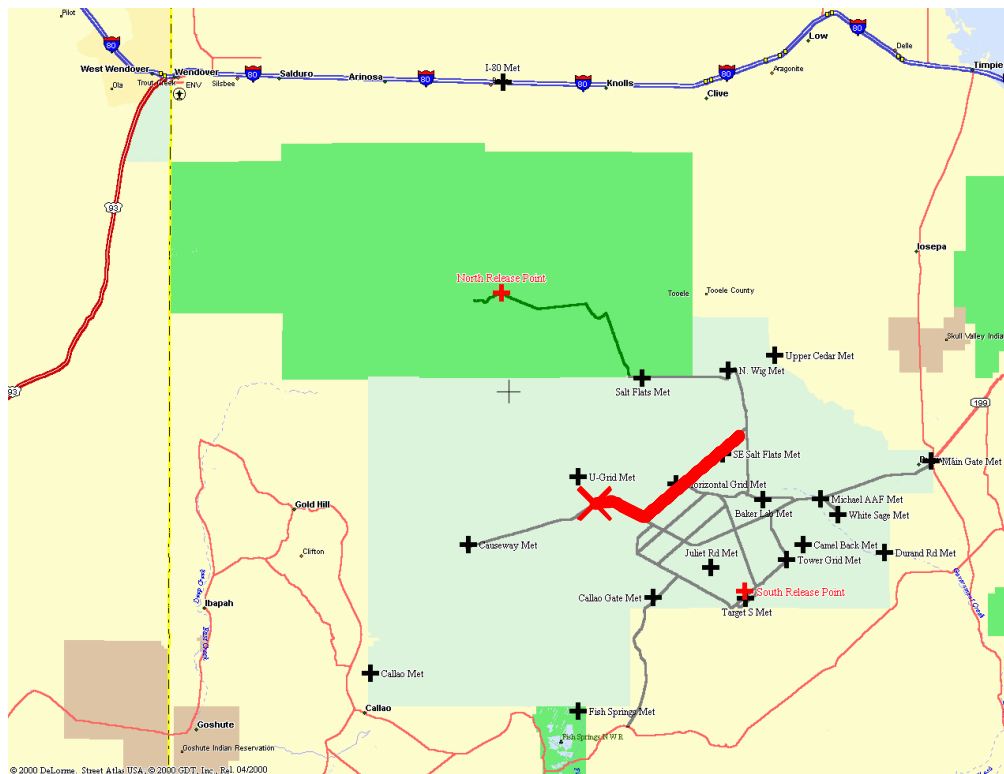
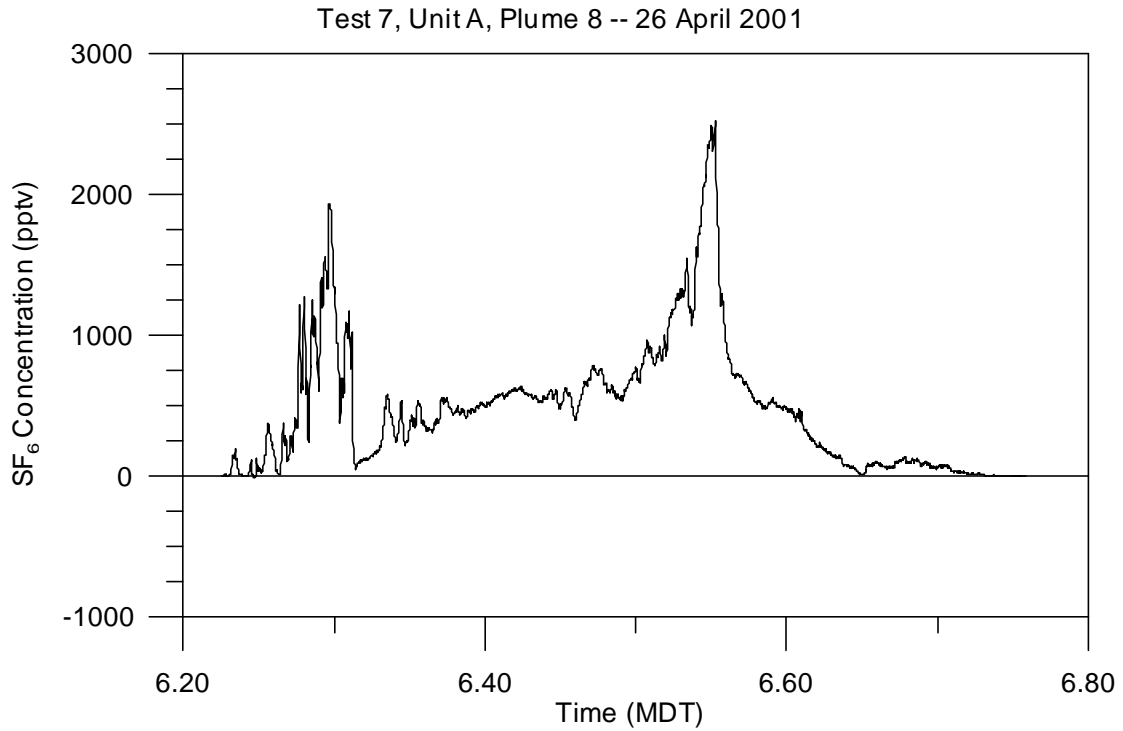


Figure A-237. SF₆ concentration of Plume 8 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

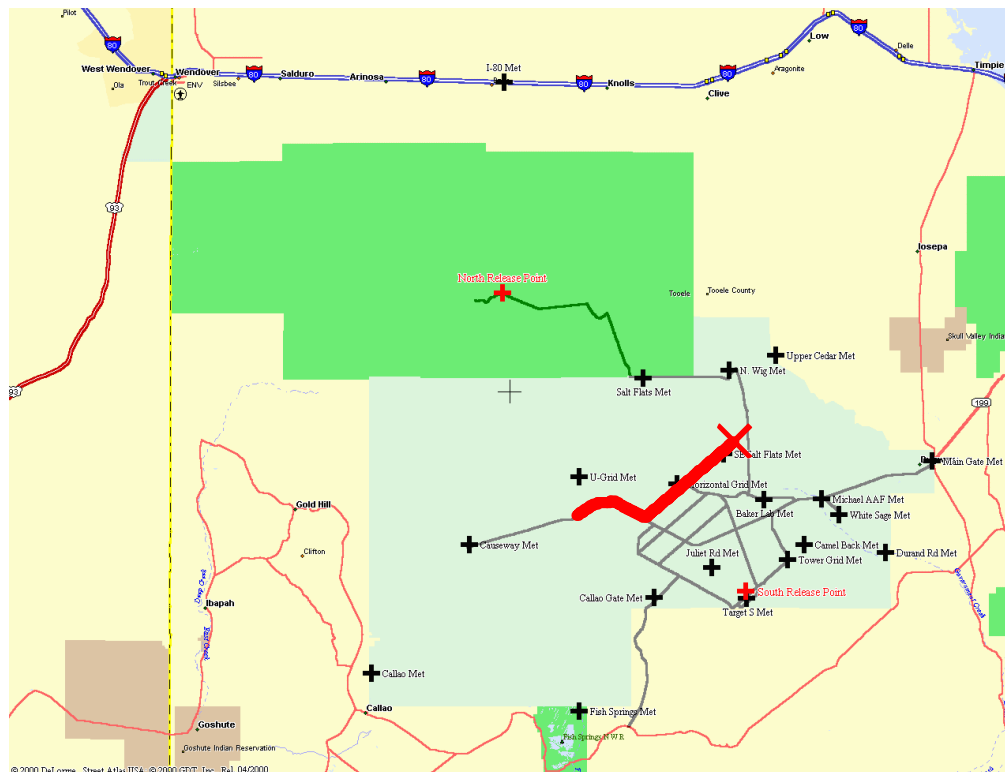
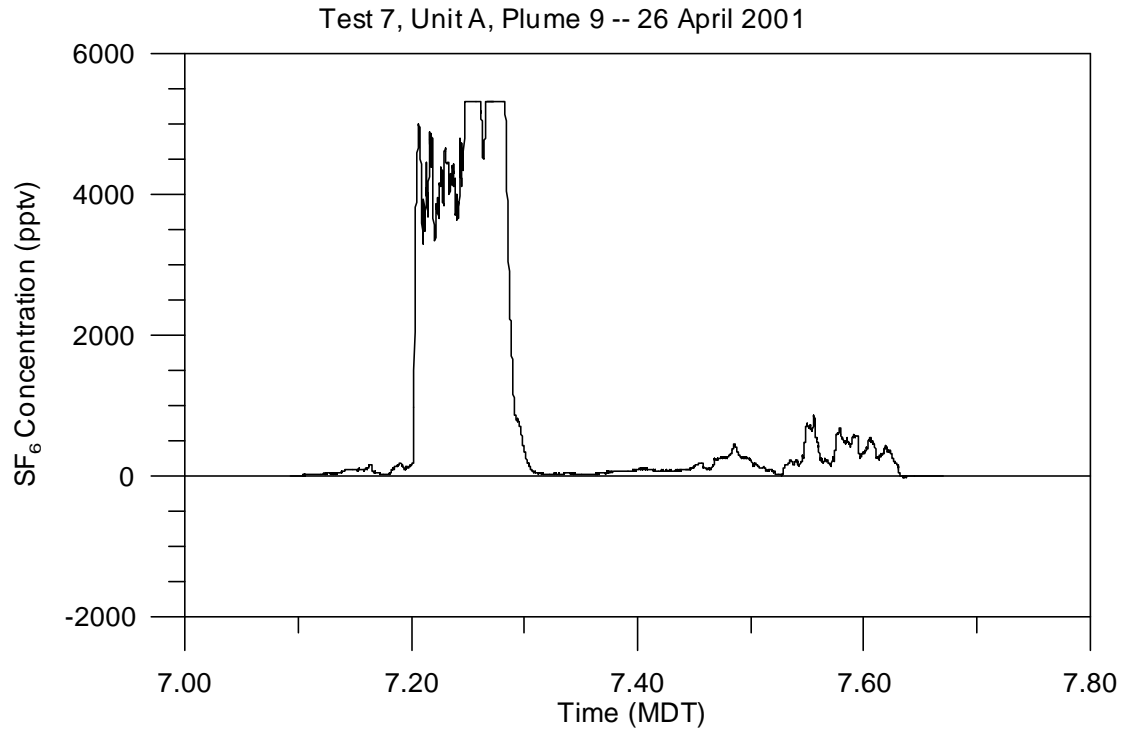


Figure A-238. SF₆ concentration of Plume 9 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

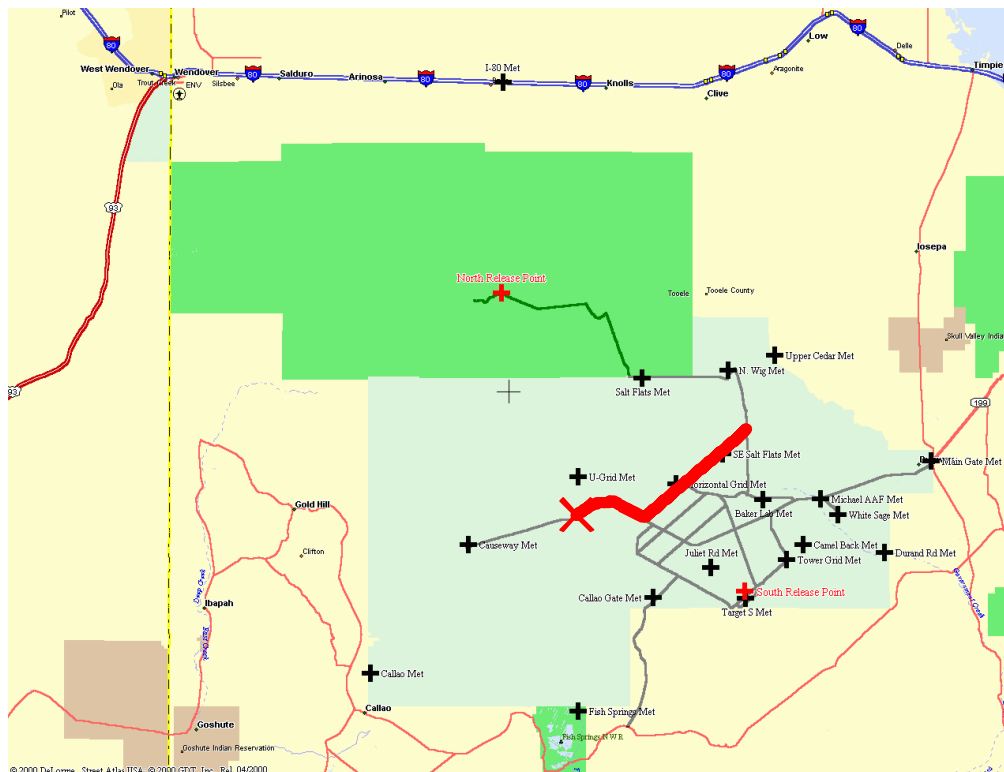
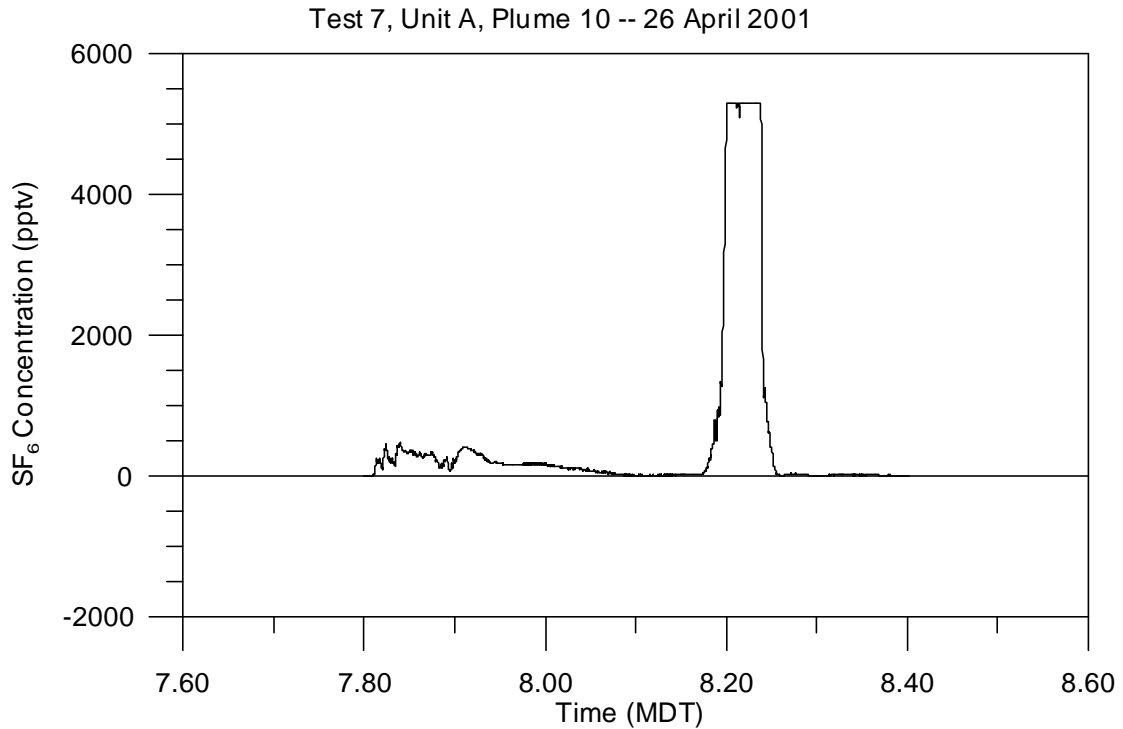


Figure A-239. SF₆ concentration of Plume 10 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

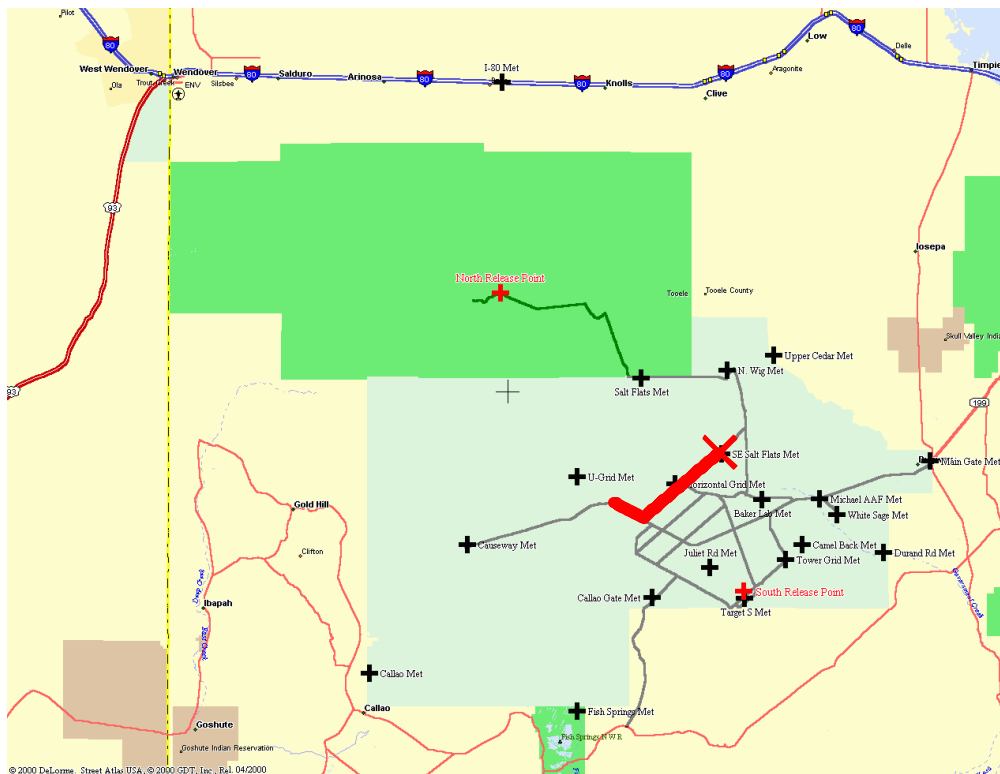
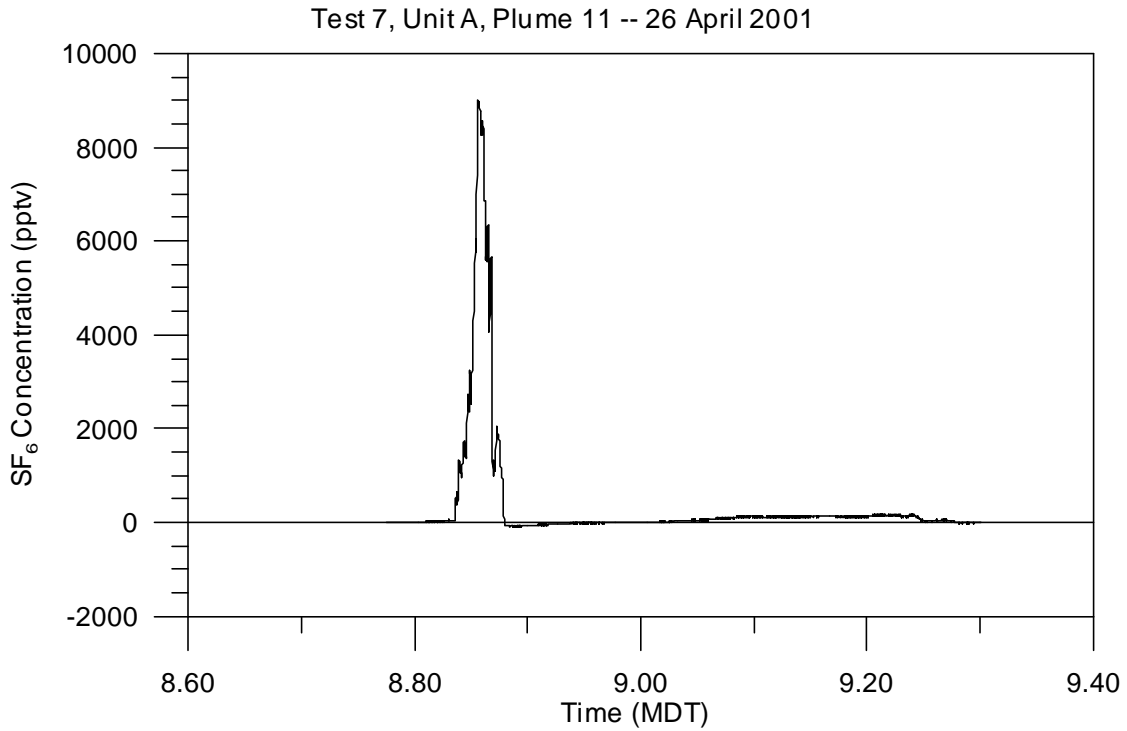


Figure A-240. SF₆ concentration of Plume 11 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

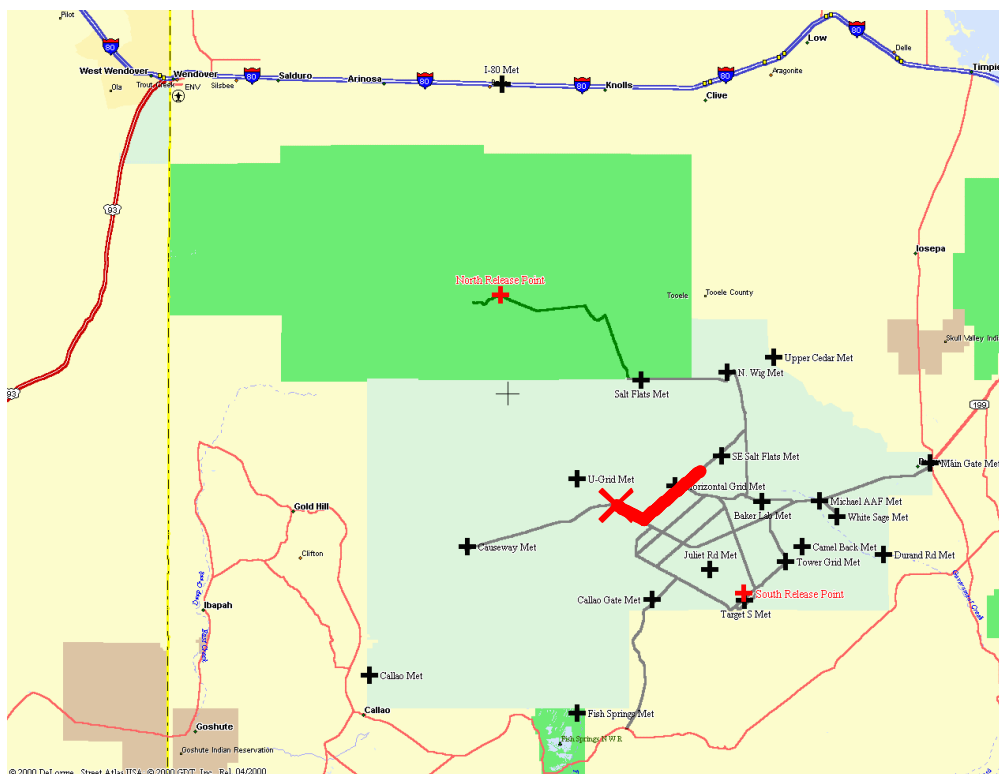
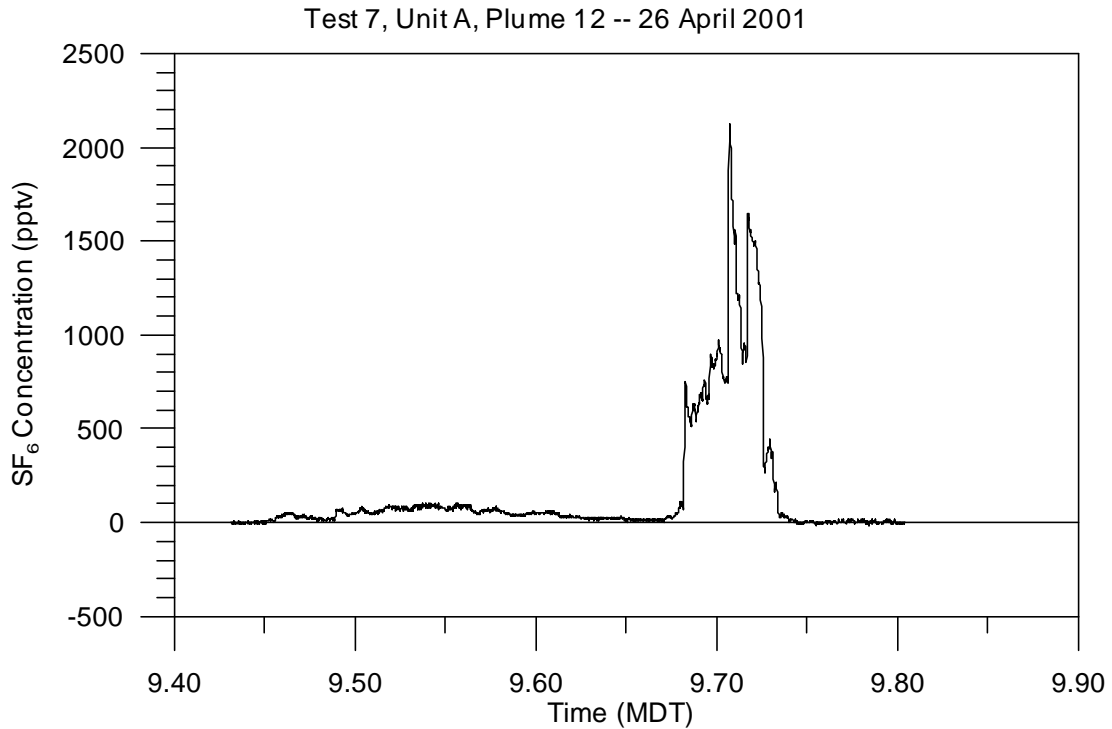


Figure A-241. SF₆ concentration of Plume 12 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

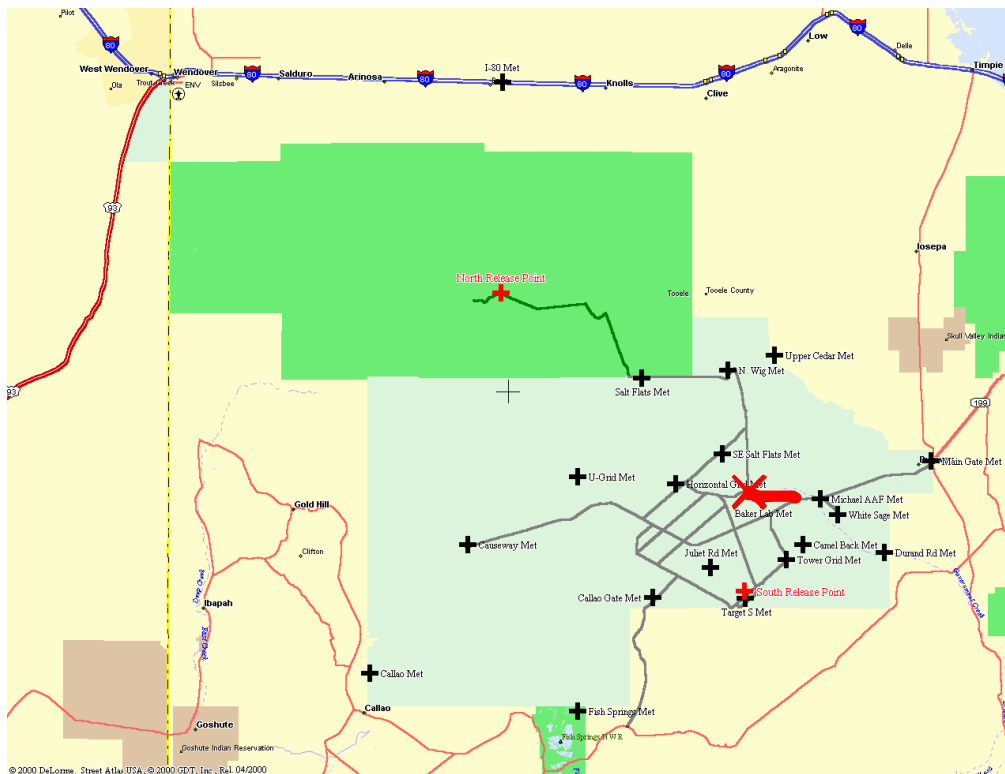
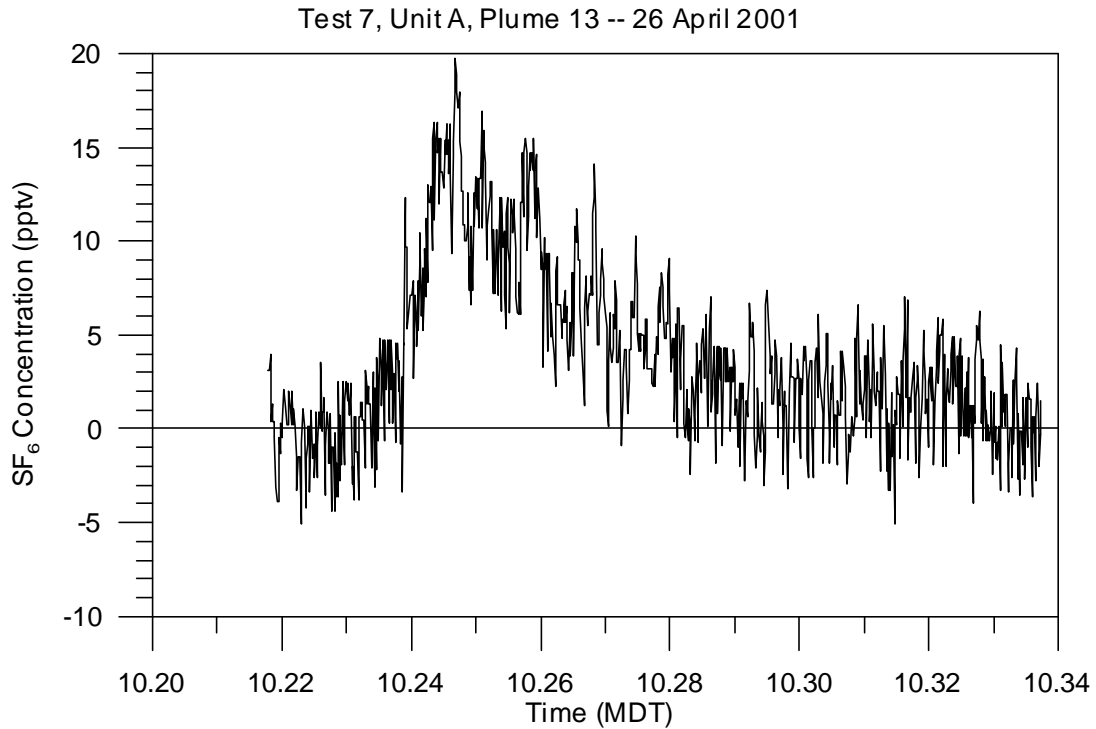


Figure A-242. SF₆ concentration of Plume 13 for Sampling Unit A during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 7 Sampling Unit B

Table A-62. Test 7 Sampling Unit B sampling traverses yielding no detectable SF₆ (null pass) prior to first SF₆ plume encounter.

Null Traverse Number	Beginning Time (MDT)	Ending Time (MDT)
1	3:00	3:39
2	4:15	4:40
3	4:44	5:07

Table A-63. Summary of individual SF₆ plume characteristics measured by Sampling Unit B during Test 7. Bearings and ranges are given to the South Release Point (Target S Grid).

Plume Number	Time (MDT)	Number of Data Points	Bearings (degrees)	Ranges		
				Min (km)	Avg (km)	Max (km)
1	5:35-5:43	1023	322.6-327.8	49.42	50.88	52.82
2	5:44-5:55	1343	328.4-331.5	46.87	48.12	49.15
3	6:02-6:26	2881	331.5-345.5	32.41	37.31	45.26
4	6:46-8:28	12348*	316.9-348.0	32.09	47.05	58.45
5	8:50-10:18	10544*	320.8-348.7	32.01	43.84	56.00

*Large number of data points mandated using every other data point in this analysis.

Table A-64. Maximum SF₆ concentration together with time of occurrence, location of occurrence, and calculated bearing and range to the South Release Point (Target S Grid) of each individual plume traverse measured by Sampling Unit B during Test 7.

Plume Number	Concentration (pptv)	Time (MDT)	Latitude (degrees N)	Latitude (degrees W)	Bearing (degrees)	Range (km)
1	30.2	5:39	40.432285	113.397018	324.6	50.90
2	22.0	5:52	40.438503	113.319053	331.5	47.96
3	386.2	6:12	40.359325	113.260078	331.9	37.84
4	2168.3*	6:57	40.358600	113.259148	331.9	37.73
5	1760.9*	9:02	40.341340	113.240307	332.8	35.29

*Large number of data points mandated using every other data point in this analysis.

No null passes were made by Sampling Unit B either during or after the time period of active plume sampling listed in the previous two tables.

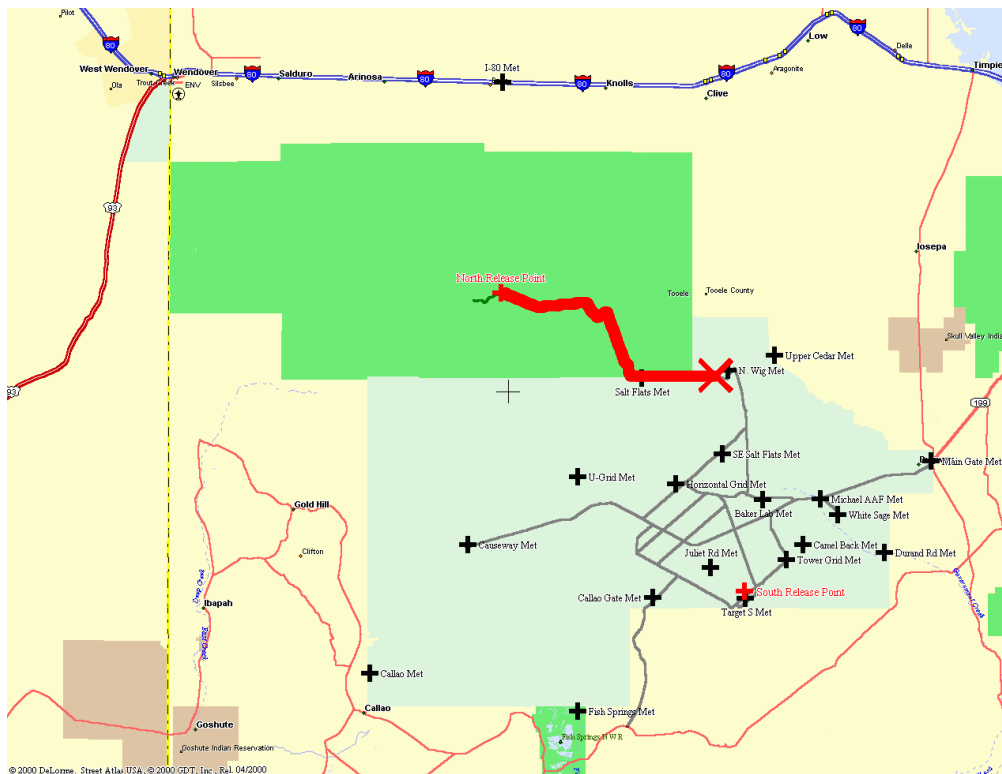
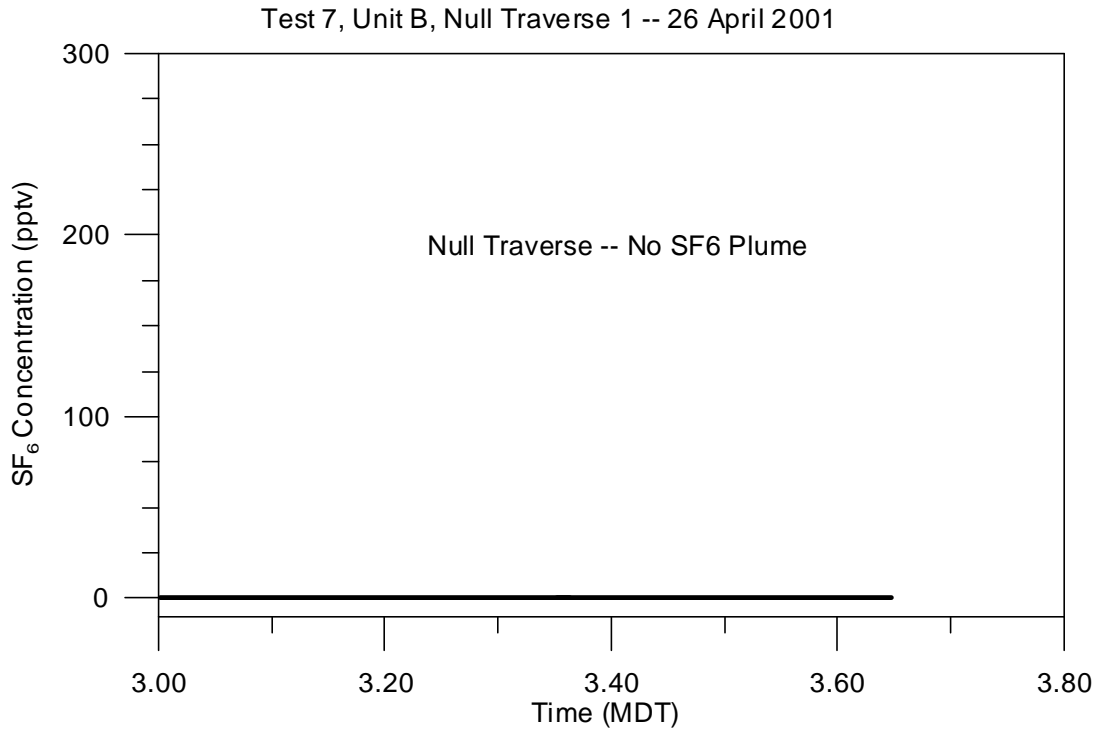


Figure A-243. Null sampling traverse 1 made by Sampling Unit B during Test 7, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

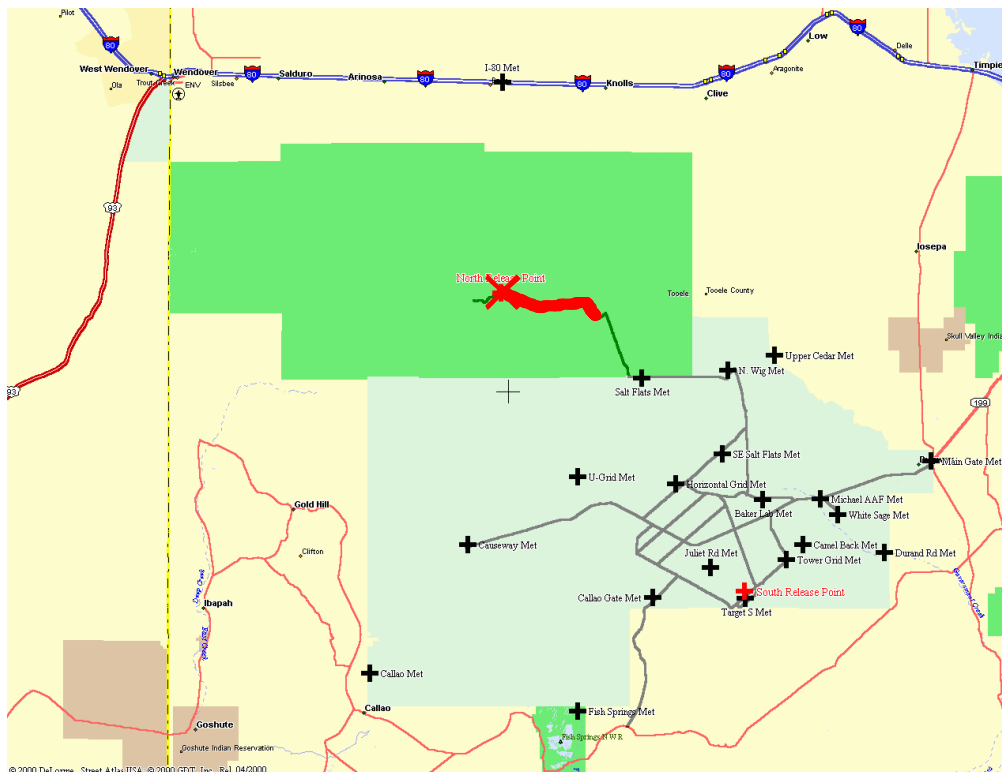
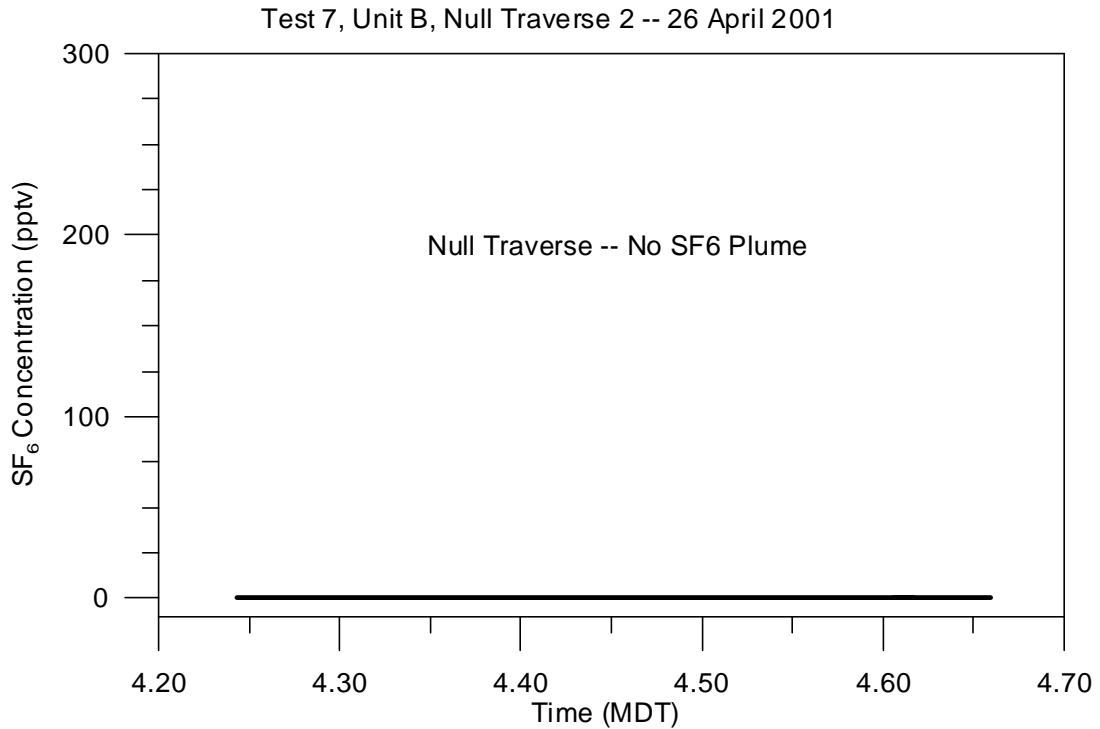


Figure A-244. Null sampling traverse 2 made by Sampling Unit B during Test 7, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

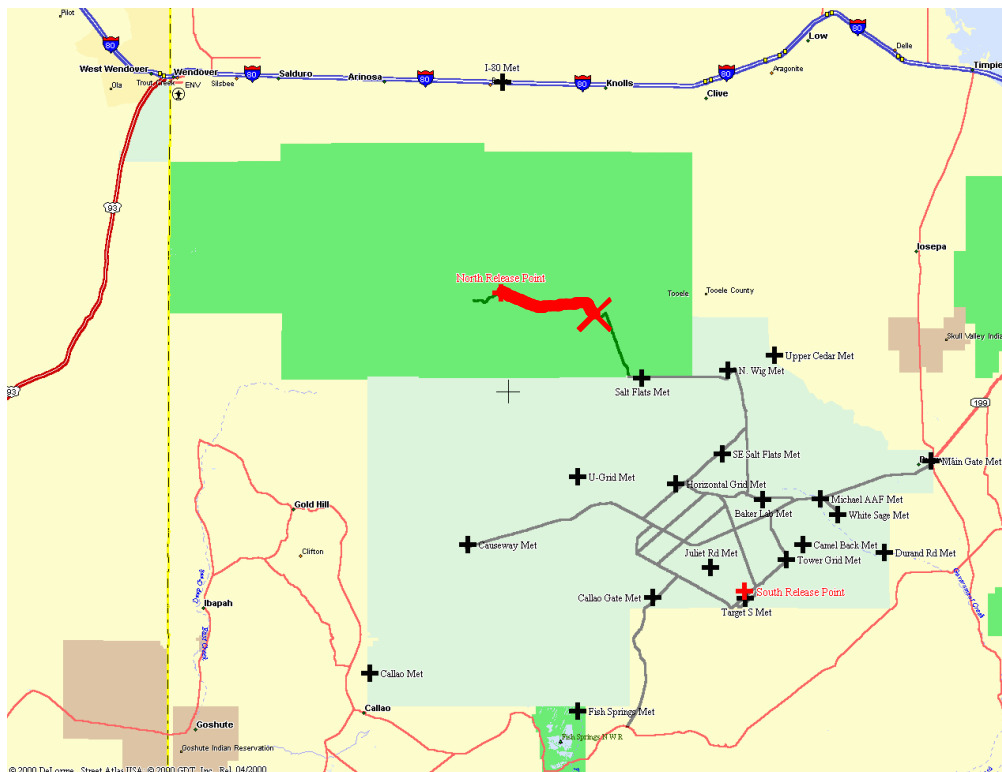
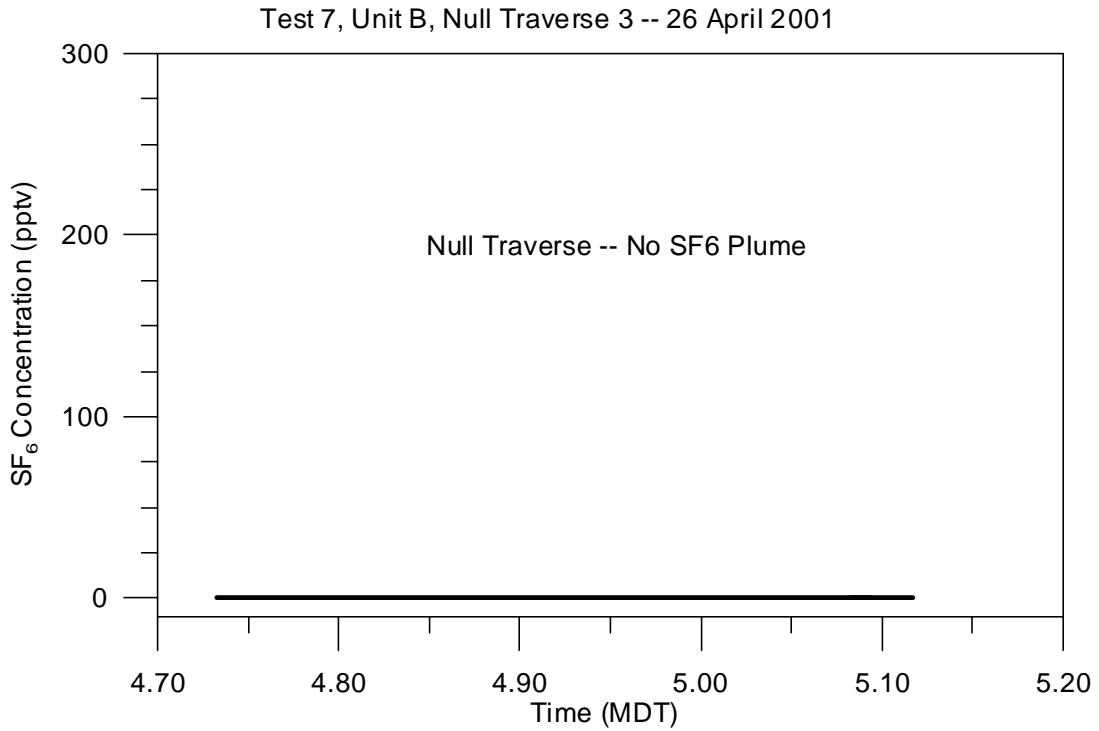


Figure A-245. Null sampling traverse 3 made by Sampling Unit B during Test 7, indicating time of the traverse (dark line, top), and the location of the sampling track (bottom). X indicates the beginning of the traverse.

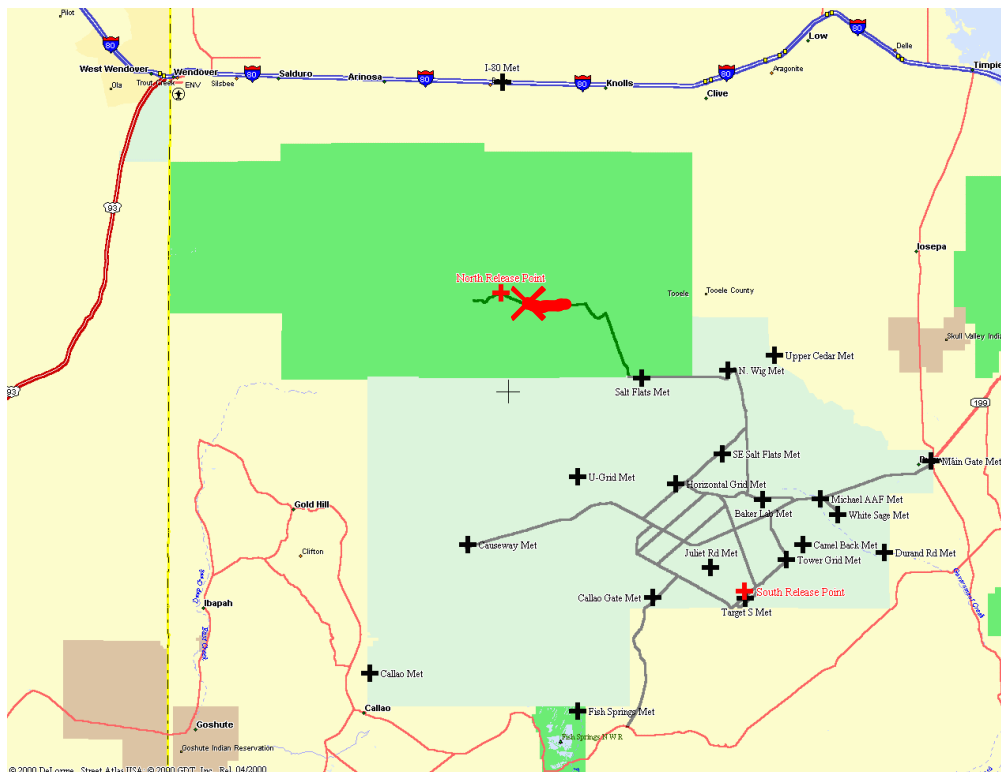
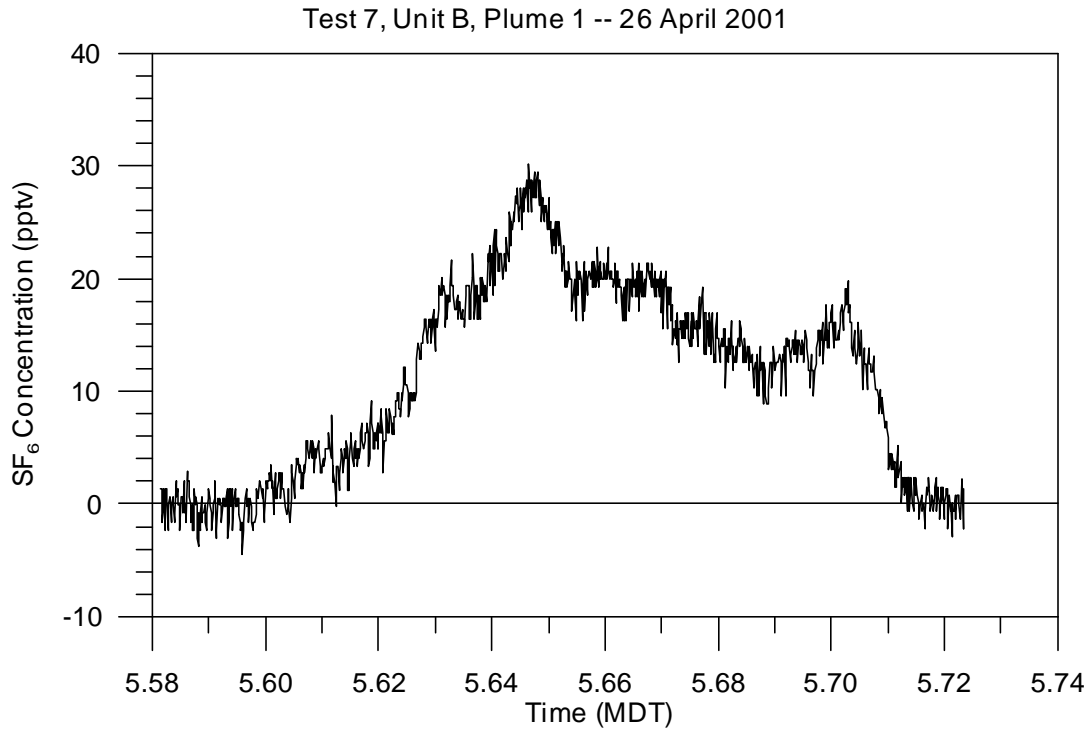


Figure A-246. SF₆ concentration of Plume 1 for Sampling Unit B during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

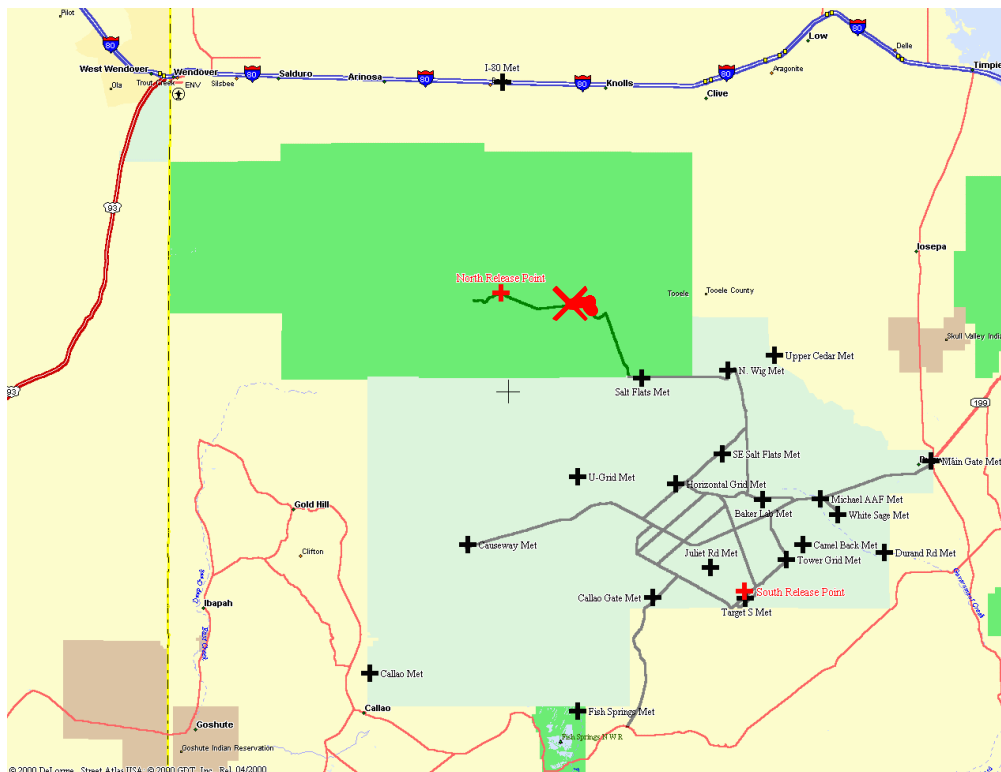
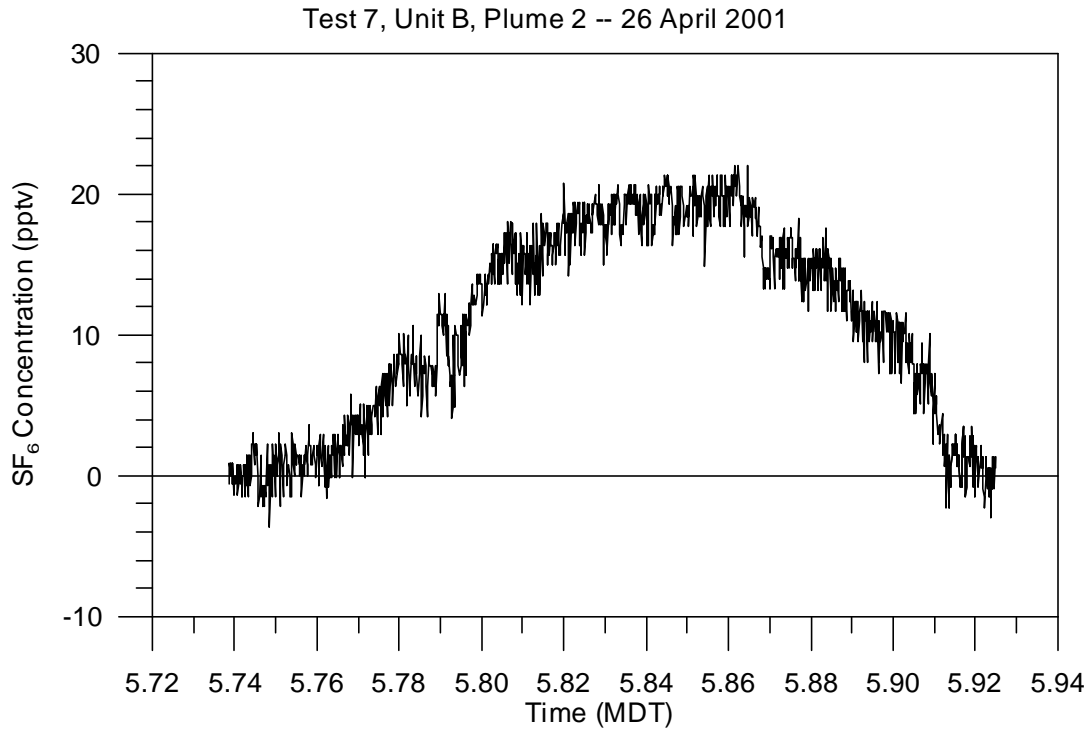


Figure A-247. SF₆ concentration of Plume 2 for Sampling Unit B during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

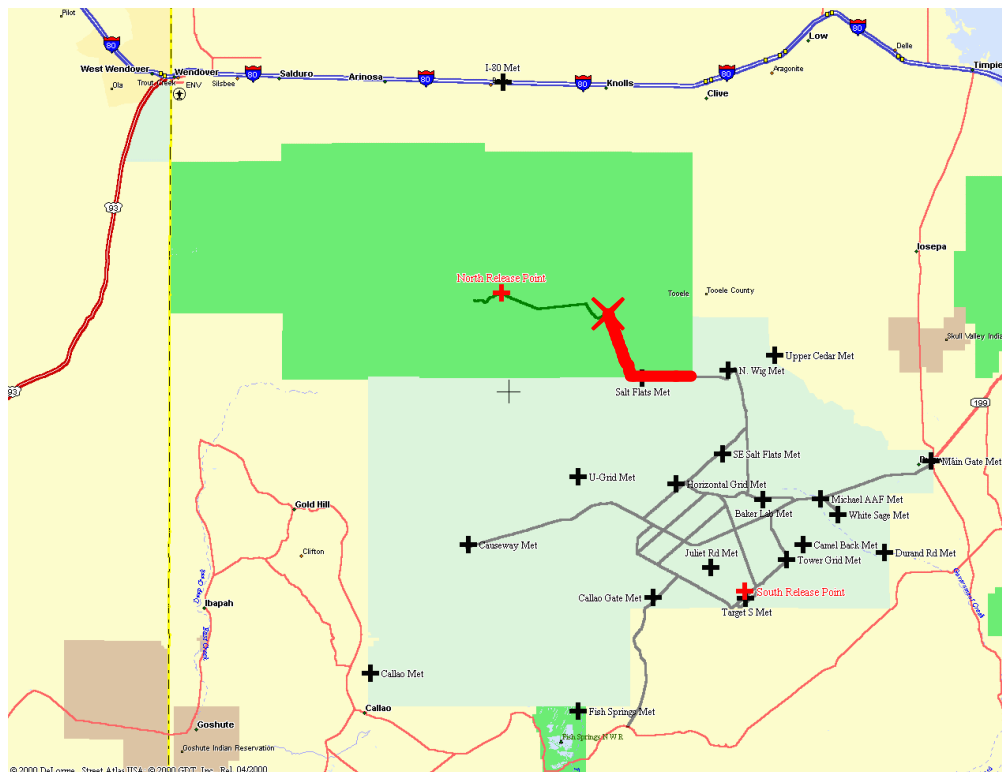
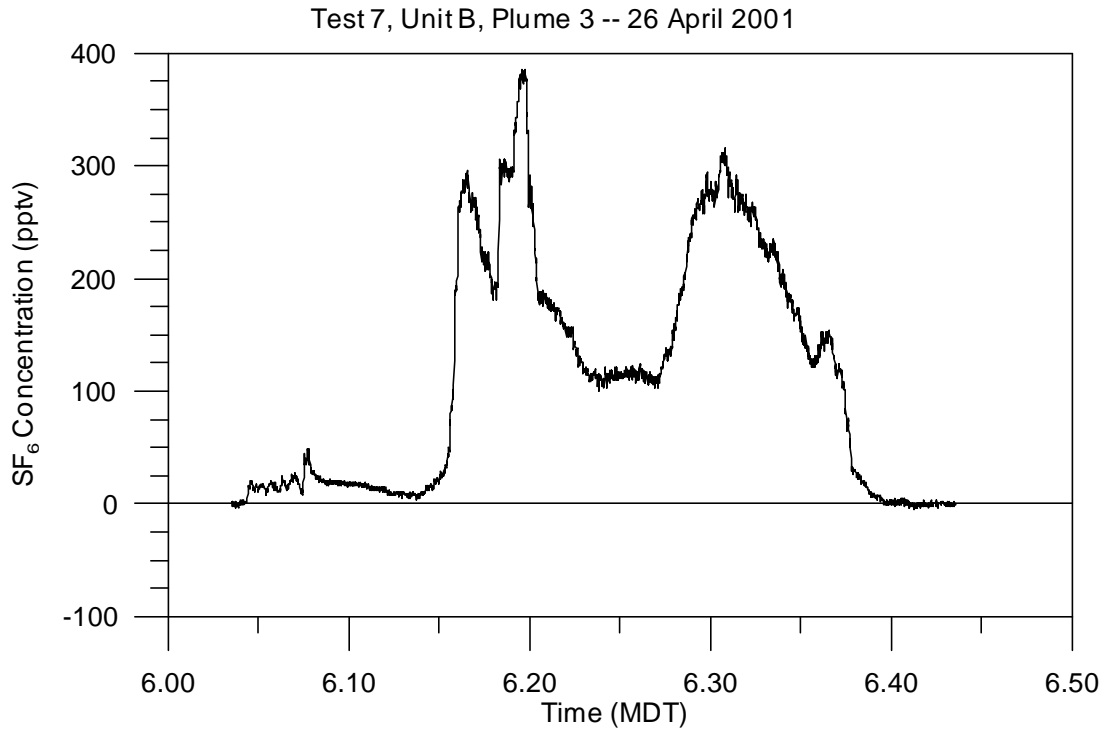


Figure A-248. SF₆ concentration of Plume 3 for Sampling Unit B during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

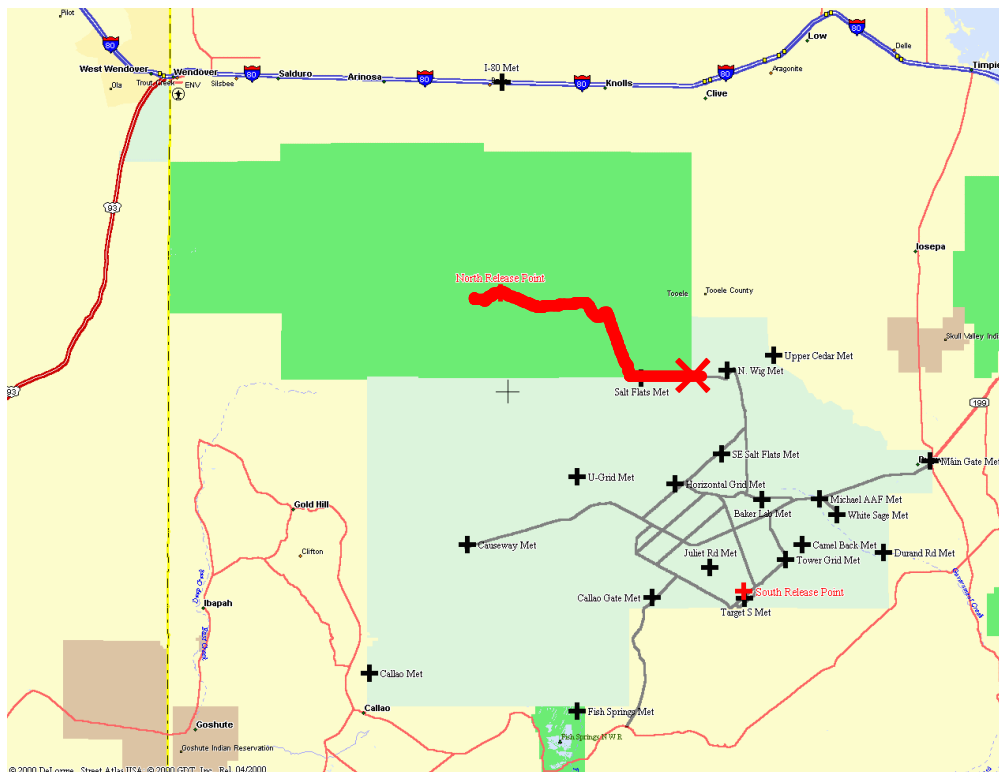
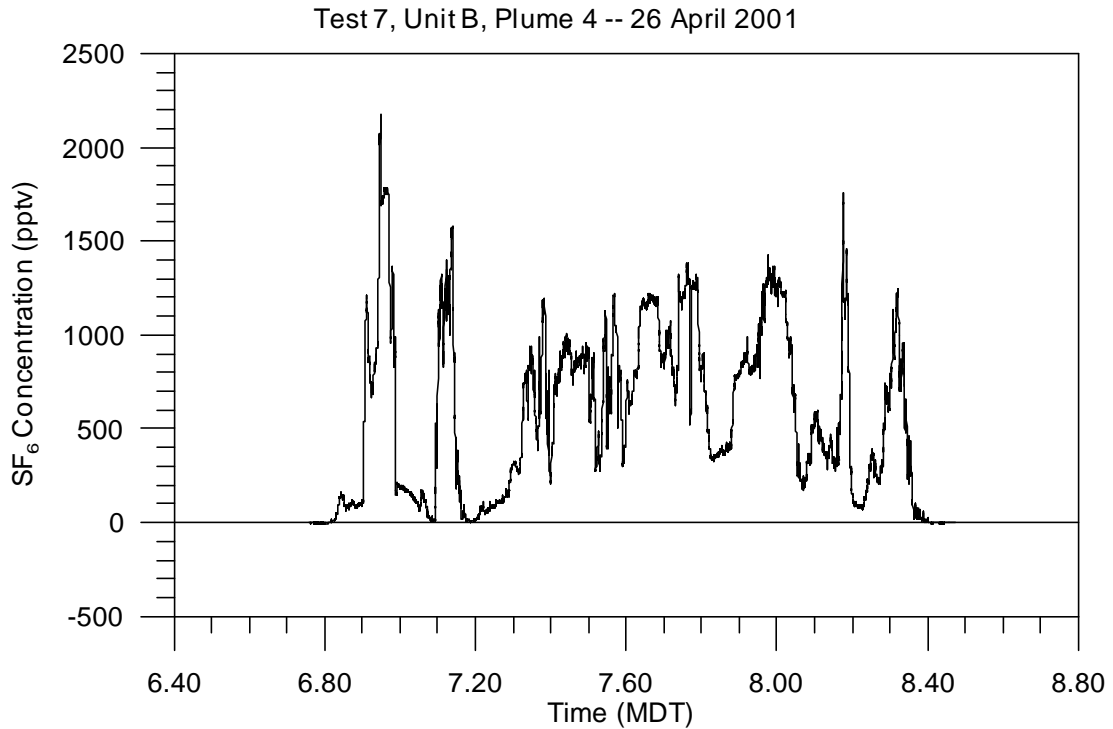


Figure A-249. SF₆ concentration of Plume 4 for Sampling Unit B during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

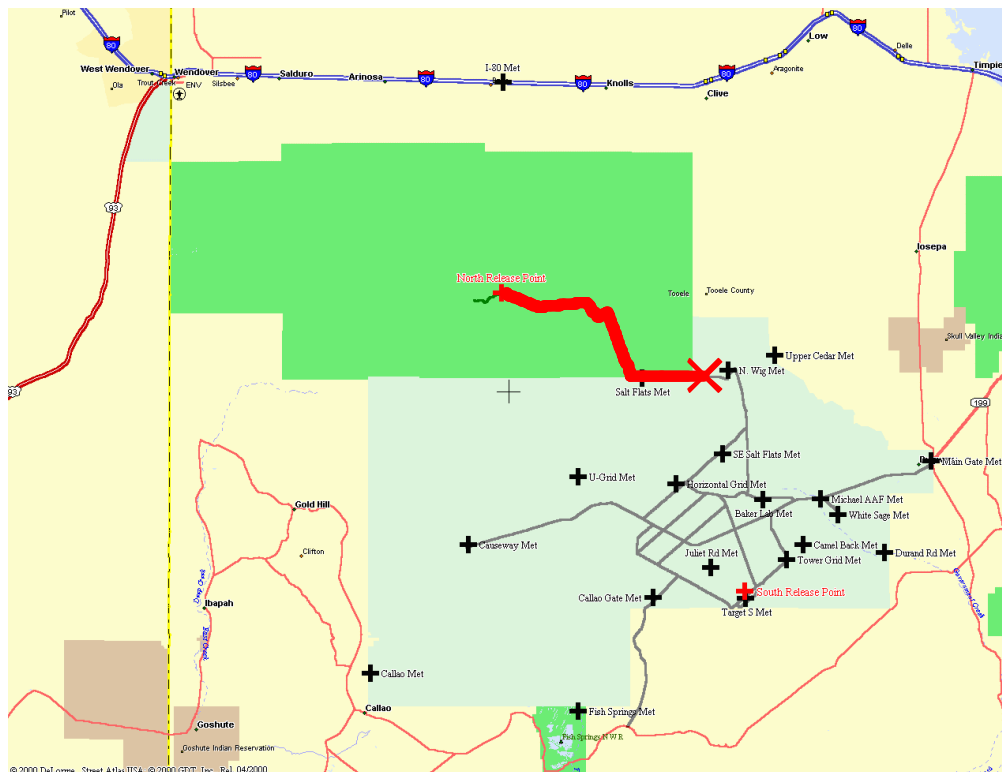
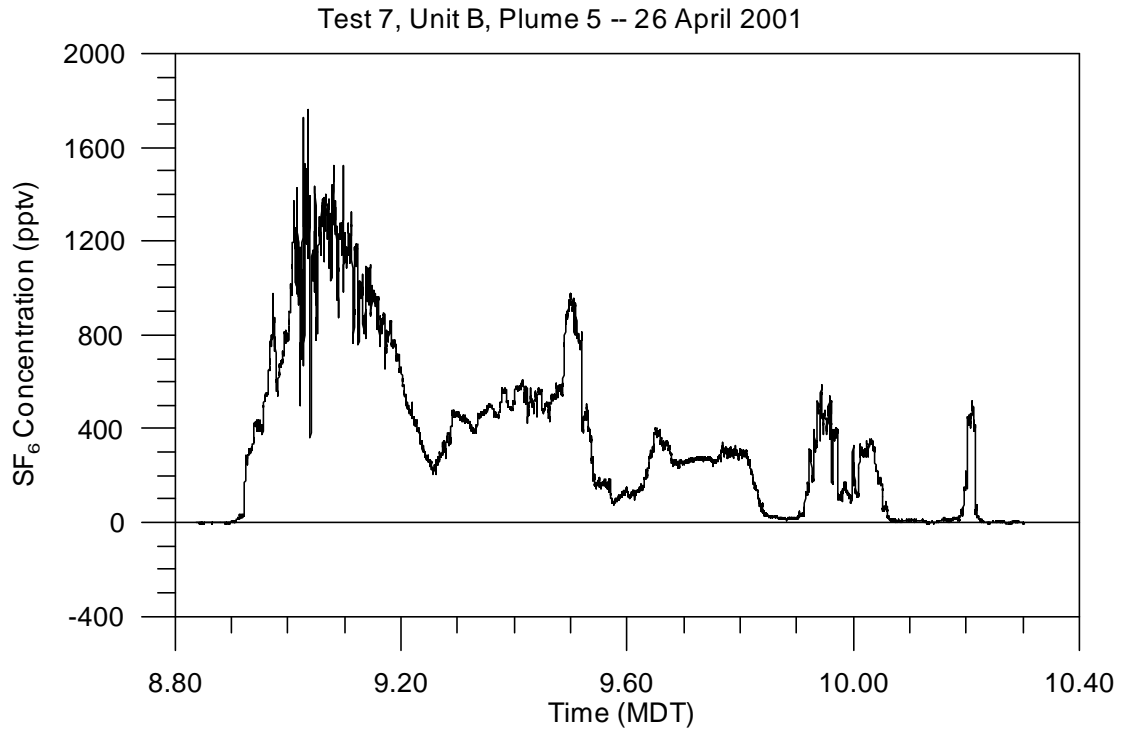


Figure A-250. SF₆ concentration of Plume 5 for Sampling Unit B during Test 7 as a function of time (top) and location of the sampling track (bottom). X indicates the beginning of the traverse.

Test 7
Sampling Unit C

Sampling Unit C was not used during Test 7, as instructed by the AFTAC controller.

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